TELEDYNE LECROY
Everywhereyoulook™

Getting Started Manual

LabMaster 9 Zi-A Oscilloscopes

LabMaster 9 Zi-A Oscilloscopes

Getting Started Manual

May, 2013

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The oscilloscope is warranted for normal use and operation, within specifications, for a period of three years from shipment. Teledyne LeCroy will either repair or, at our option, replace any product returned to one of our authorized service centers within this period. However, in order to do this we must first examine the product and find that it is defective due to workmanship or materials and not due to misuse, neglect, accident, or abnormal conditions or operation.

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The oscilloscope's firmware has been thoroughly tested and is presumed to be functional. Nevertheless, it is supplied without warranty of any kind covering detailed performance. Products not made by Teledyne LeCroy are covered solely by the warranty of the original equipment manufacturer.

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Welcome

Thank you for purchasing a Teledyne LeCroy product. We're certain you'll be pleased with the detailed features so unique to our instruments.

This *LabMaster 9 Zi-A Getting Started Manual* is designed to cover important safety and installation information for your oscilloscope, along with standard procedures so you're quickly working on waveforms. The Teledyne LeCroy website at teledynelecroy.com maintains the most current specification information and the online help file on your instrument may be accessed for more comprehensive documentation. Sections of the online help residing on your oscilloscope may be printed and transferring the help file itself to a USB memory device is a fairly common procedure. Details on how to access your online help file can be found in a .pdf file on the desktop of your oscilloscope.

This manual is arranged in the following manner:

- Physical features such as hardware, basic controls, display
- Core oscilloscope functions such as timebase and vertical setup
- Special features such as customization, LabNotebook, Save/Recall (File) functions, and Utilities
- Reference, including certifications and contact information

When your product is delivered, verify that you've received all items on the packing list or invoice copy. Contact your nearest Teledyne LeCroy customer service center or national distributor if anything is missing or damaged. We can only be responsible for replacement if you contact us immediately.

We truly hope you enjoy using Teledyne LeCroy's fine products.

Sincerely,

David C. Graef

Teledyne LeCroy Corporation
Vice President and Chief Technology Officer

Safety Instructions

This section contains instructions that must be observed to keep the instrument operating in a correct and safe condition. You are required to follow generally accepted safety procedures in addition to the precautions specified in this section. **The overall safety of any system incorporating this instrument is the responsibility of the assembler of the system.**

Symbols

These symbols appear on the instrument's front or rear panels and in documentation to alert you to important safety considerations.

CAUTION of damage to instrument, or **WARNING** of hazard to health. Attend to the accompanying information to protect against personal injury or damage. Do not proceed until conditions are fully understood and met.

WARNING. High Voltage. Risk of electric shock.

Measurement ground connection.

Safety (protective) ground connection.

Alternating Current.

Standby Power (front of 9CZi-A, MCM-Zi, and 9xxMZi-A).

Power On (back of 9xxMZi-A); connected to AC mains.

Power Off (back of 9xxMZi-A); disconnected from AC mains.

Precautions

Use proper power cord. Use only the power cord shipped with this instrument and certified for the country of use.

Maintain ground. This product is grounded through the power cord grounding conductor. To avoid electric shock, connect only to a grounded mating outlet.

Connect and disconnect properly. Do not connect/disconnect probes or test leads while they are connected to a voltage source.

Observe all terminal ratings. Do not apply a voltage to any input (C1, C2, C3, C4 or EXT) that exceeds the maximum rating of that input. Refer to the front of the oscilloscope for maximum input ratings.

Use only within operational environment listed. Do not use in wet or explosive atmospheres.

Use indoors only.

Keep product surfaces clean and dry.

Do not block the cooling vents. Leave a minimum six-inch (15 cm) gap between the instrument and the nearest object. Keep the underside clear of papers and other objects.

Do not remove the covers or inside parts. Refer all maintenance to qualified service personnel.

Do not operate with suspected failures. Do not use the product if any part is damaged. Obviously incorrect measurement behaviors (such as failure to calibrate) might indicate impairment due to hazardous live electrical quantities. Cease operation immediately and sequester the instrument from inadvertent use.

Operating Environment

Temperature: 5 to 40 °C.

Humidity: Maximum relative humidity 80 % for temperatures up to 31 °C decreasing linearly to 50 % relative humidity at 40 °C (or at the upper operational temperature limit).

Altitude: Up to 10,000 ft (3,048 m) at or below 25 °C.

Cooling

The instrument relies on forced air cooling with internal fans and vents. Take care to avoid restricting the airflow to any part of the oscilloscope. Around the sides and rear, leave a minimum of 15 cm (6 inches) between the instrument and the nearest object. At the bottom, the oscilloscope feet (up or down) provide adequate clearance.

CAUTION. Do not block oscilloscope vents. Always keep the area beneath the oscilloscope clear of paper and other items.

The instrument also has internal fan control circuitry that regulates the fan speed based on the ambient temperature. This is performed automatically after start-up.

Cleaning

Clean only the exterior of the oscilloscope using a damp, soft cloth. Do not use harsh chemicals or abrasive elements. Under no circumstances submerge the instrument or allow moisture to penetrate it. Avoid electric shock by unplugging the power cord from the AC outlet before cleaning.

CAUTION. Do not attempt to clean internal parts. Refer to qualified service personnel.

Calibration

The oscilloscope is calibrated at the factory prior to being shipped. The recommended calibration interval is one year. Calibration should be performed by qualified personnel only.

The oscilloscope software includes automatic and user-initiated deskew calibration functions.

Schedule an annual factory calibration as part of your regular maintenance. Extended warranty, calibration, and upgrade plans are available for purchase. Contact your Teledyne LeCroy sales representative or customersupport@teledynelecroy.com to purchase a service plan.

Power

AC Power Source

100 to 240 VAC (+/-10%) at 50/60 Hz (+/-10%)

Manual voltage selection is not required because the instrument automatically adapts to line voltage.

Power Consumption

9XXMZI-A MASTER ACQUISITION MODULE

13-20 GHz Models
Max Power Consumption (all accessories installed): ≤ 850 watts (850 VA)
Power consumption in Standby Mode: 10 Watts.

30-45 GHz DBI Models
Max Power Consumption (all accessories installed): ≤ 900 watts (900 VA)
Power consumption in Standby Mode: 10 Watts.

CPU MODULE - INCLUDED WITH LABMASTER 9XXMZI-A

Max Power Consumption (all accessories installed): ≤ 400 watts (400 VA)
Power consumption in Standby Mode: 5 Watts.

9CZI-A MASTER CONTROL MODULE

Max Power Consumption (all accessories installed): ≤ 450 watts (450 VA)
Power consumption in Standby Mode: 5 Watts.

MCM-ZI MASTER CONTROL MODULE

Max Power Consumption (all accessories installed): ≤ 450 watts (450 VA)
Power consumption in Standby Mode: 5 Watts.

9XXSZI-A SLAVE ACQUISITION MODULE

13-20 GHz Models
Max Power Consumption (all accessories installed): ≤ 700 watts (700 VA)
Power consumption in Standby Mode: 12 Watts.

30-45 GHz Models
Max Power Consumption (all accessories installed): ≤ 750 watts (750 VA)
Power consumption in Standby Mode: 12 Watts.

Power and Ground Connections

The **9xxMZi-A Master Acquisition Module** is provided with a 15A/250V 14AWG rated grounded cord set containing a molded three-terminal polarized plug and a specific IEC-60320 (Type C15) connector for making line voltage and safety ground connections.

The **9CZi-A** and **MCM-Zi Master Control Modules** , **9xxSZi-A Acquisition Module**, and the **CPU Module** are provided with standard 10A/250V 18AWG rated grounded cord sets with IEC320 right-angle Type C13 connectors.

The AC inlet ground is connected directly to the frame of the instrument. For adequate protection again electric shock, connect to a mating outlet with a safety ground contact.

WARNING. Interrupting the protective conductor inside or outside the oscilloscope, or disconnecting the safety ground terminal, creates a hazardous situation. Intentional interruption is prohibited.

Standby Power

The **Standby** (Power) button controls the operational state of the **Master Control Module** (LabMaster 9CZi-A or MCM-Zi), the **Master Acquisition Module** (LabMaster 9xx-MZi-A), and the **CPU Module**.

- Press the button to switch the instrument into Standby mode (reduced power); press it again to return to full operation.
- Press and hold the button for 5 seconds to power off the instrument.

On the 9CZi-A Master Control Module, the color of the **LED** below the Standby button indicates the operational state of the oscilloscope:

- **Steady green** – fully powered and operational
- **Blinking green** – computer subsystems on Standby (reduced power); all other subsystems fully powered.
- **Off** – powered off except for some housekeeping circuits.

On the MCM-Zi Master Control Module, LED indicator will be either:

- **Blue**– fully powered and operational.
- **Off**– powered off except for some housekeeping circuits.

Always use the Standby button or the **File > Shutdown** menu option to execute a proper shut down process and preserve settings before powering down. Do not shut down by pulling the power cord from the socket or shutting off a connected power strip.

The Standby button does not disconnect the oscilloscope from the AC power supply. The only way to fully power down the instrument is to use the rear Power switch (if available), or unplug the AC power cord from the outlet.

We recommend unplugging the instrument if it will be unused for a long period of time.

CAUTION. Do not change the instrument's Windows Power Options setting from the default Never to System Standby or System Hibernate. Doing so can cause the system to fail.

LabMaster Overview

LabMaster is a unique modular oscilloscope solution that allows a configuration of more channels at higher bandwidths than traditional four channel oscilloscopes. It is ideally suited for test situations where there are many lanes of serial data to be captured and analyzed simultaneously, where crosstalk analysis is performed, or for capturing four channels at the highest-possible bandwidths for optical coherent modulation applications. Each LabMaster consists of a single Master Acquisition Module or Master Control Module, and optional additional Slave Acquisition Modules. Slaves can be added at any time for easy channel upgrades. Bandwidth upgrades are available for both Master Acquisition Modules and Slave Acquisition Modules for future scalability.

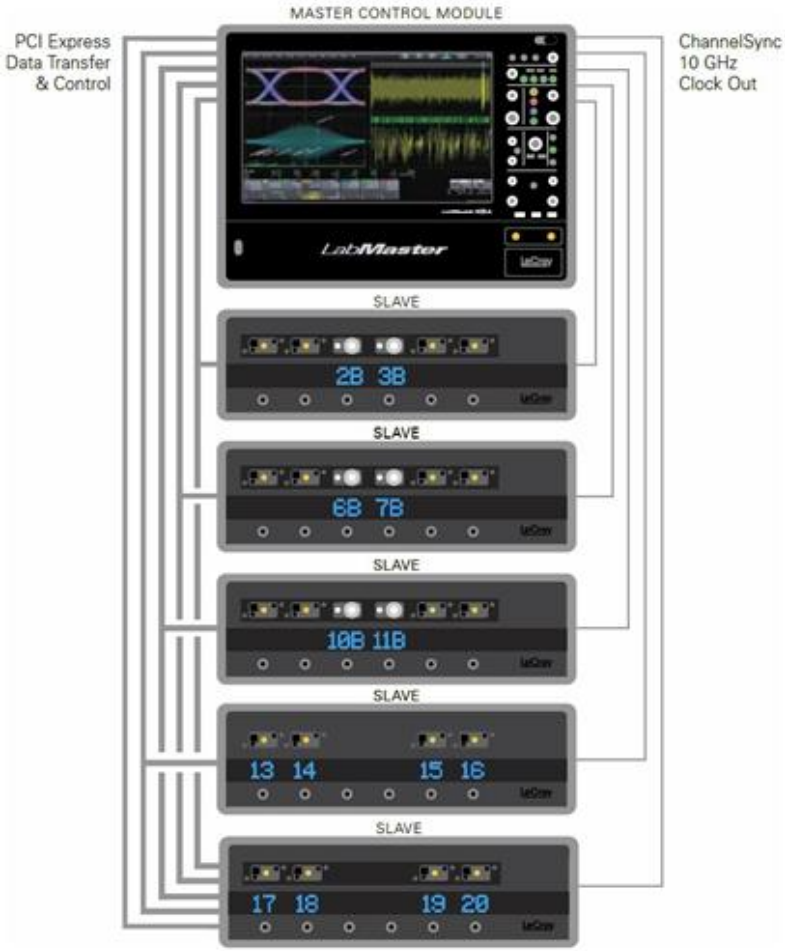
Unique ChannelSync™ architecture ensures precise synchronization between all oscilloscope channels located in different acquisition modules. A single 10 GHz distributed clock signal is generated in the Master Acquisition Module or Master Control Module, and then used in or distributed to as many as five Master Acquisition Modules or Slave Acquisition Modules. The 10 GHz clock frequency - 1000 times faster than the 10 MHz reference clocks commonly used to synchronize lab equipment - ensures precise synchronization and high-timebase accuracy between all acquisition modules. Additionally, a single trigger signal is used for all acquisition modules to completely eliminate trigger jitter between modules, such as would be found when two conventional oscilloscopes are synchronized with 10 MHz clocks and a common trigger signal. The system also ensures Acquisition Modules are automatically identified to the Master, and software de-skew calibration routines allow for fast calibration and correction for any static acquisition skew between all acquisition modules.

NOTE: Detailed steps explaining how to set up either configuration are covered in Configuration Setups Overview (on page 25).

Master Control Module Configuration

This configuration includes either a **9CZi-A Master Control Module** or **MCM-Zi Master Control Module** with up to five **Slave Acquisition Modules**.

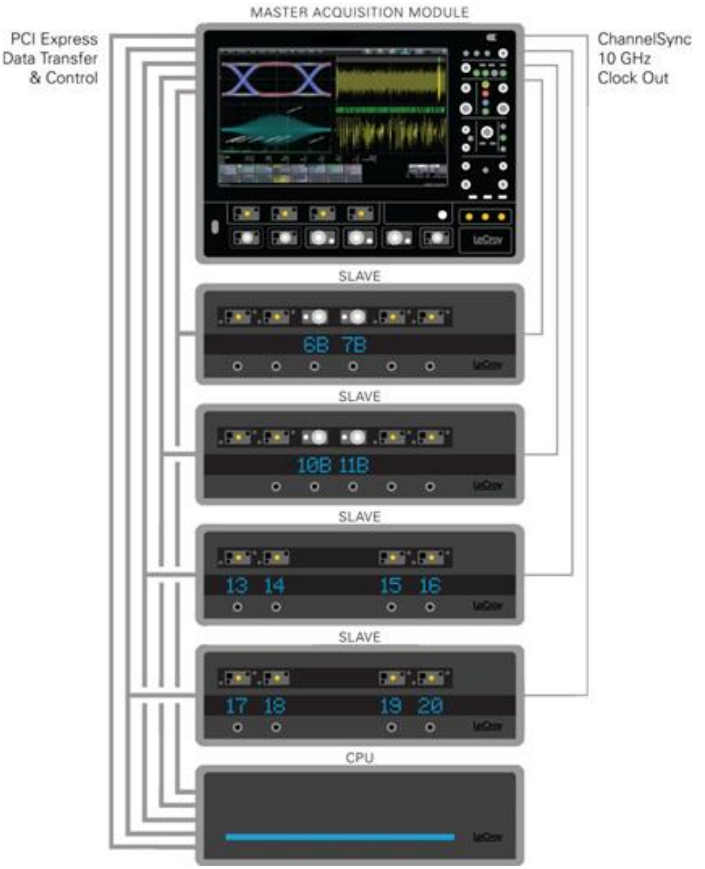
NOTE: If your LabMaster system runs multiple Slave Acquisition Module**s**, for optimal channel access and convenience, we recommend stacking the modules on top of each other on your bench, inside Teledyne LeCroy's OC910 Oscilloscope Cart, or inside of your own rack (modules must be specifically ordered for rack mounting from the Teledyne LeCroy factory).



9CZi-A Master Control Module with up to five 9xxSZi-A Slave Acquisition Modules

Master Acquisition Module Configuration

This configuration includes a **9xxMZi-A Master Acquisition Module** with corresponding **CPU Module**, and **up-to-four 9xxSZi-A Slave Acquisition Modules**.



9xxMZi-A Master Acquisition Module with CPU Module and four 9xxSZi-A Slave Acquisition Modules

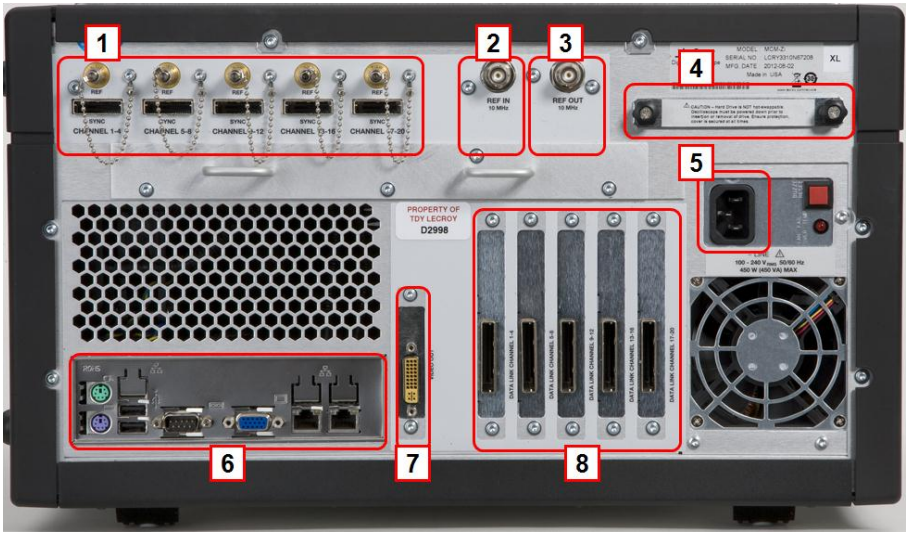
NOTE: The 9xxSZi-A Slave Acquisition Module**s** are available in a variety of bandwidths and channel density configurations. Each example shown previously contains a mix of 20 GHz and >20 GHz Slave Acquisition Module**s**. Each Slave Acquisition Module is compatible with either Master Module (Control or Acquisition). Refer to specifications on the datasheet maintained at teledynelecroy.com, or contact your Teledyne LeCroy representative for details.

Front of MCM-Zi Master Control Module

The MCM-Zi Master Control Module includes **Controls**, **Display**, **CPU**, and **ChannelSync Clock Architecture**. All acquisition capability is contained in separate Acquisition Modules.

Number and Description		
1. Power Button	**3.** Host USB Ports	**5.** Front Panel Control Release Switch
2. Fast Edge Output	**4.** Detachable Front Panel Control	

Back of MCM-Zi Master Control Module



Number and Description		
1. ChannelSync Outputs - SMA 10 GHz Clock and PCIe 1 Lane Control Connections (for corresponding Acquisition Modules)	**3.** 10 MHz Reference Clock Input (Grounded EMI Shield required when port is not in use)	**6.** Input/Output Panel
2. 10 MHz Reference Clock Output	**4.** Removable Storage Drive	**7.** DVI-D Video Output
	5. AC Power Inlet	**8.** PCIe 4 Lane Data Inputs (from corresponding Acquisition Modules)

PLEASE NOTE THE FOLLOWING:

- Cap-off unused ChannelSync SMA sockets (item 1) using the provided chain-linked 50 Ω terminations (not shown).
- 10 MHz Reference Clock Inputs are specifically intended for synchronization with other instruments; not between Master Control Module and Acquisition Modules.
- DVI-D Video Output is for use with an additional external monitor for Extended Desktop mode.
- The AUX IN connection is for 50 Ω input only.

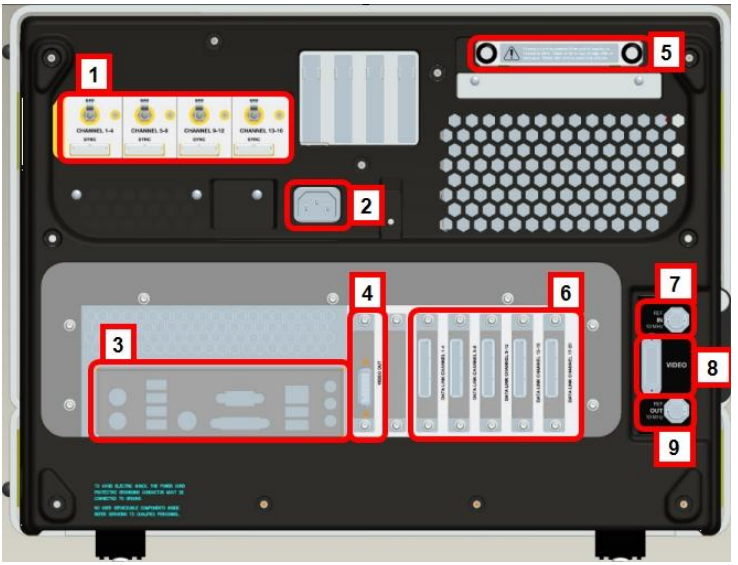
- The PCIe 4 Lane Data Inputs (item 8) also accommodate PCIe Expansion Slot options for GPIB and LSIB. Option cards must be specified when ordering and installed at the Teledyne LeCroy factory into any number of the same five slots used for the Acquisition Modules. The slot between the DVI-D Video Output connector and the PCIe 4 Lane Data Connection for Channels 1-4 is unavailable.

Front of 9CZi-A Master Control Module

The **9CZi-A Master Control Module** includes **Controls**, **Display**, **CPU**, and **ChannelSync Clock Architecture**. All acquisition capability is contained in separate **Slave Acquisition Modules**.

Number and Description		
1. Power Button	**3.** USB Ports	**5.** Front Panel Control Release Switch
2. Fast Edge Output	**4.** Detachable Front Panel Control	

Back of 9CZi-A Master Control Module



Number and Description		
1. Channel Sync Outputs - SMA 10 GHz Clock and PCIe 1 Lane Control Connections (for corresponding Slave Acquisition Modules)	**4.** DVI-D Video Output	**7.** 10 MHz Reference Clock Input (Grounded EMI Shield required when port is not in use)
2. AC Power Plug	**5.** Removable Hard Drive	**8.** DVI-D Video Input (from DVI-D Video Output on CPU)
3. Input/Output Panel (on page 20)	**6.** PCIe 4 Lane Data Inputs (from corresponding Slave Acquisition Modules).	**9.** 10 MHz Reference Clock Output

PLEASE NOTE THE FOLLOWING:

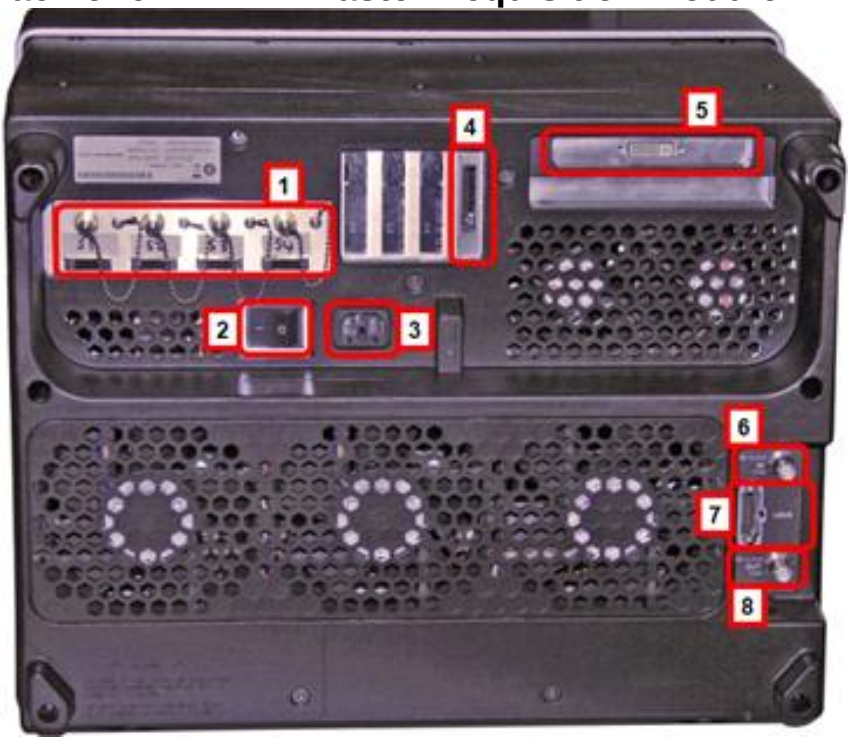
- Cap-off unused ChannelSync SMA sockets (item 1) using the provided chain-linked 50 Ω terminations (not shown).
- DVI-D Video Output and Input connectors (items 5 and 6) must be connected with the supplied 1 foot cable for your touch-screen display to function.
- The PCIe 4 Lane Data Inputs (item 6) also accommodate PCIe Expansion Slot options for GPIB and LSIB. Option cards must be specified when ordering and installed at the Teledyne LeCroy factory into any number of the same five slots used for the Acquisition Modules. The slot between the DVI-D Video Output connector and the PCIe 4 Lane Data Connection for Channels 1-4 is unavailable.
- The AUX IN connection for 50 Ω input only is provided on the back of the 9CZi-A Master Control Module.
- 10 MHz Reference Clock Inputs are specifically intended for synchronization with other instruments; not between Master and Slave modules.

Front of 9xxMZi-A Master Acquisition Module

The **9xxMZi-A Master Acquisition Module** includes Controls**,** Display**,** ChannelSync Clock Architecture**,** and a single, internal acquisition system**.** The CPU is contained in the separate, physical **CPU Module**, but is included with the **LabMaster 9xxMZi-A**. Additional acquisition capability is contained in separate **Slave Acquisition Modules**.

Number and Description		
1. Power Button	**5.** Volume Control and Mute Button	**9.** USB Ports
2. Channel Row LED Indicator	**6.** Ground Connector	**10.** Detachable Front Panel Control
3. Channel Inputs	**7.** Speaker	**11.** Front Panel Control Release Switch
4. Auxiliary Input and Output	**8.** Fast Edge, Recovered Clock, and Data Outputs	

Back of 9xxMZi-A Master Acquisition Module



Number and Description		
1. Channel Sync Outputs - SMA 10 GHz Clock and PCIe 1 Lane Control Connections (for corresponding Slave Acquisition Modules)	**4.** PCIe 1 Lane DATA Output (to CPU Module)	**6.** 10 MHz Reference Clock Input (Grounded EMI Shield required when port is not in use)
2. Power Switch	**5.** DVI-D Video Input (for DVI-D Output Signal from CPU)	**7.** LBUS Output
3. AC Power Plug		**8.** 10 MHz Reference Clock Output

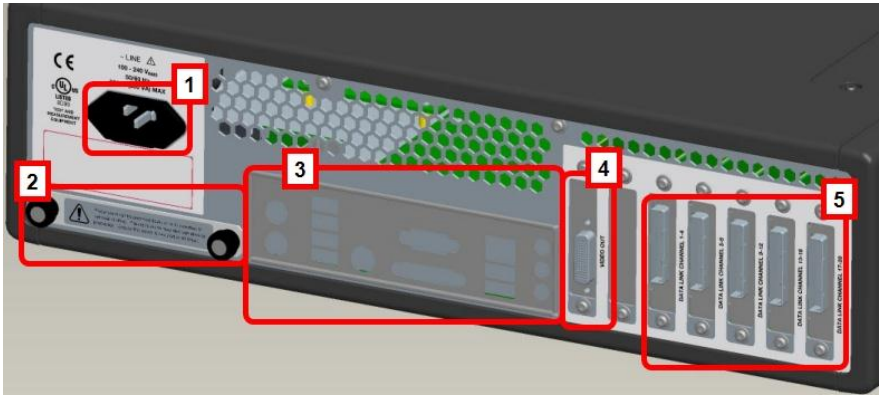
PLEASE NOTE THE FOLLOWING:

- Cap off unused ChannelSync SMA sockets (item 1) using the provided chain-linked 50 Ω terminations.
- VGA/WXGA Video Input connectors (item 5) must be connected with the supplied 1 meter cable to the VGA/WXGA Video Output on the CPU Module for your touch-screen display to function.
- 10 MHz Reference Clock Inputs are specifically intended for synchronization with other instruments; not between Master and Slave modules.

Front of CPU Module

In the Master Acquisition Module configuration, the **9xxMZi-A Master Acquisition Module** connects to a separate **CPU Module**, shown below.

Back of CPU Module



Number and Description					
1.	AC Power Plug	**3.**	The I/O Panel	**5.**	PCIe 4 Lane Data Inputs (from corresponding Slave Acquisition Modules).
2.	Removable Hard Drive	**4.**	DVI-D Video Output		

PLEASE NOTE THE FOLLOWING:

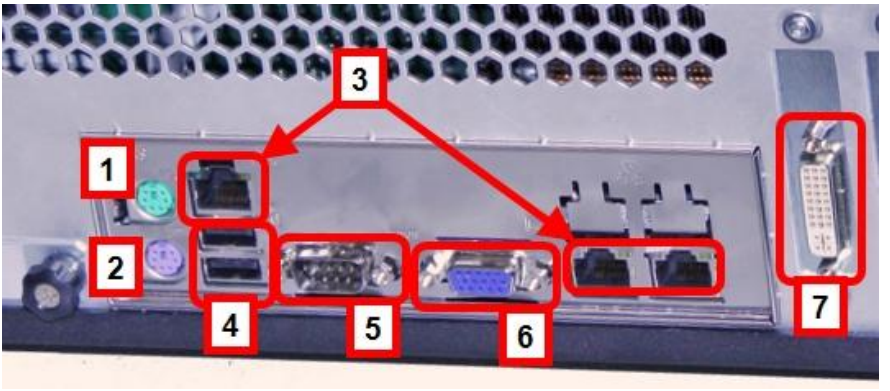
- The PCIe 4 Lane Data Inputs (item 5) also accommodate PCIe Expansion Slot options for GPIB and LSIB. Option cards must be specified when ordering and installed at the Teledyne LeCroy factory into any number of the same five slots used for the Acquisition Modules. The slot between the DVI-D Video Output connector and the PCIe 4 Lane Data Connection for Channels 1-4 is unavailable.
- The DVI-D Video Output connector (item 4) must be connected to the DVI-D Video Input on the back of the 9xxMZi-A Master Acquisition Module with the supplied 1 meter cable for your touch-screen display to function.

Input/Output Panel

9CZi-A Master Control Module and 9xxMZi-AMaster Acquisition Module

The available connections are the same, only the location differs:

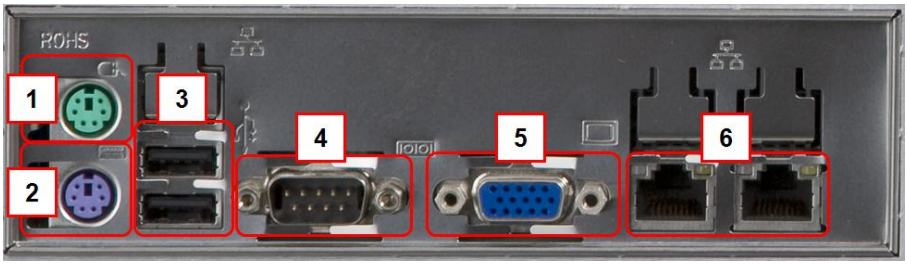
- I/O panel is on the back of the **9CZi-A Master Control Module** unit (on page 14).
- I/O panel is on the back of the **CPU Module** (on page 17) corresponding to 9xxMZi-A Master Acquisition Module.



Number and Description		
1. Mouse	**3.** Ethernet Ports	**6.** 15-pin VGA/WXGA Video Output
2. Keyboard	**4.** USB Ports	**7.** DVI-D Video Output
	5. 15-pin VGA/WXGA Video Input	

MCM-Zi Master Control Module

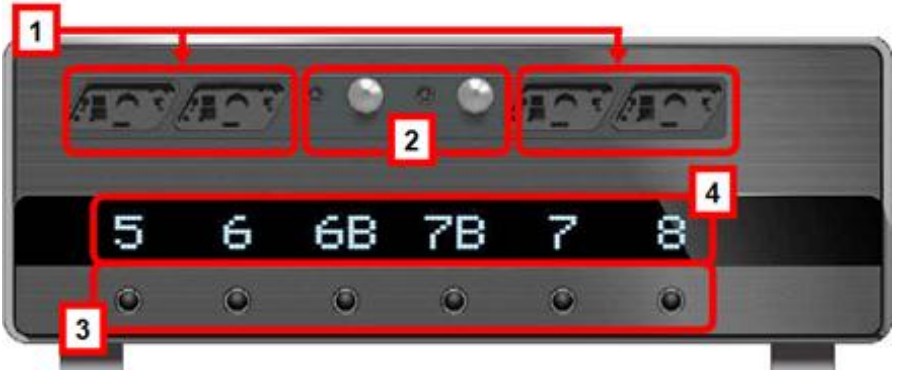
The I/O panel is located on the back of the MCM-Zi Master Control Module (page 12).



Number and Description		
1. Mouse 2. Keyboard 3. Host USB Ports	4. 9-pin Serial Port (disabled) 5. 15-pin Video Output (disabled)	6. Ethernet ports (LAN)

NOTE: The MCM-Zi motherboard is a server-class motherboard with certain I/O capabilities (serial port, VGA/WXGA video output) that are not utilized by the MCM-Zi, even though the physical connectors remain on the I/O panel. The 9-pin serial port is used for communication to the server motherboard, and the 15-pin video connector only outputs text debug messages from the motherboard. Since these capabilities are not useful for the MCM-Zi, they are disabled in the BIOS and will not provide any I/O should you connect to them.

Front of 9xxSZi-A Slave Acquisition Module



Number and Description		
1. ProLink Compatible Inputs	**2.** 2.4/2.92 mm Compatible Inputs (on >20 GHz Model Slave Acquisition Modules Only)	**3.** Channel ON/OFF Buttons **4.** Corresponding Channel Number Indicators

PLEASE NOTE THE FOLLOWING:

- If your LabMaster system runs multiple Slave Acquisition Modules, for optimal channel access and convenience, we recommend stacking the modules on top of each other on your bench, inside Teledyne LeCroy's available cart, or inside of your own rack (modules must be specifically ordered for rack mounting from the Teledyne LeCroy factory).
- The 9xxSZi-A Slave Acquisition Modules are available in a variety of bandwidths and channel density configurations. Each example shown previously contains a mix of 20 GHz and >20 GHz Slave Acquisition Modules. Each Slave Acquisition Module is compatible with either Master Module (Control or Acquisition). Refer to specifications on the datasheet maintained at teledynelecroy.com.

Back of 9xxSZi-A Slave Acquisition Module

Number and Description		
1. ChannelSync PCIe 1 Lane Control Input	**3.** ChannelSync SMA 10 GHz Clock Input	**5.** AC Power Plug
2. PCIe 4 Lane Data Output	**4.** AUX IN rated for 50 Ω input	

PLEASE NOTE THE FOLLOWING:

- Only the back of the 9CZi-A Master Control Module or the back of the 9xxMZi-A Master Acquisition Module has 10 MHz Reference Clock Input/Output connections.
- 10 MHz Reference Clock Inputs are specifically intended for synchronization with other instruments; not between Master and Slave modules.

ChannelSync Mainframe Hub

The CMH-20 ChannelSync Mainframe Hub provides a simple and effective means to expand a LabMaster system beyond 20 channels (5 Acquisition Modules). This is accomplished without any degradation of the timing accuracy specifications. The Mainframe Hub is populated with cards for each acquisition module (the back panel of the CMH-20 shown below is populated with 20 cards for use with 20 Acquisition Modules, or 80 total channels).

Connect a PCIe 1 Lane cable from the MCM-Zi Channel 1-4 output to the single PCIe 1 Lane input at the lower right of the CMH-20 back panel.

Connect four PCl4 4 Lane cables from the MCM-Zi data outputs for channels 1-4, 5-8, 9-12, and 13-16 to the four PCIe 4 Lane data inputs along the bottom of the CMH-20 back panel (to the left of the PCLe 1 input).

Connect from the PCIe 1 Lane Control, PCIe 4 Lane Data, and 10 GHz ChannelSync Clock outputs to the corresponding inputs on the Acquisition Modules.

LabMaster Hardware Set Up

Overview

These instructions explain the setup of your LabMaster modules for both **Master Control Module** or **Master Acquisition Module** configurations. As mentioned previously in **LabMaster Hardware Overview** (on page 2), LabMaster modules are designed to work with one another for a variety of extensible configurations and customized solution possibilities; however, they are purchased as either **Master Control Module** or **Master Acquisition Module** configurations.

LabMaster Setup Styles

As mentioned previously, LabMaster modules are designed to work with one another for a variety of extensible configurations and customized solution possibilities. They are purchased as **Master Control Module** or **Master Acquisition Module** configurations. You can choose your own LabMaster Setup Style - meaning, you can decide to **Stack** your LabMaster modules or **Rack** them inside an available **Cart** complete with lockable front wheels.

NOTE: If your LabMaster system runs multiple Slave Acquisition Modules, for optimal channel access and convenience, Teledyne LeCroy recommends stacking the modules on top of each other on your bench, inside Teledyne LeCroy's available Cart or inside of your own rack (modules must be specifically ordered for rack mounting from the Teledyne LeCroy factory).

LabMaster Master Control Module and Master Acquisition Module stack setups

LabMaster set up inside the available cart

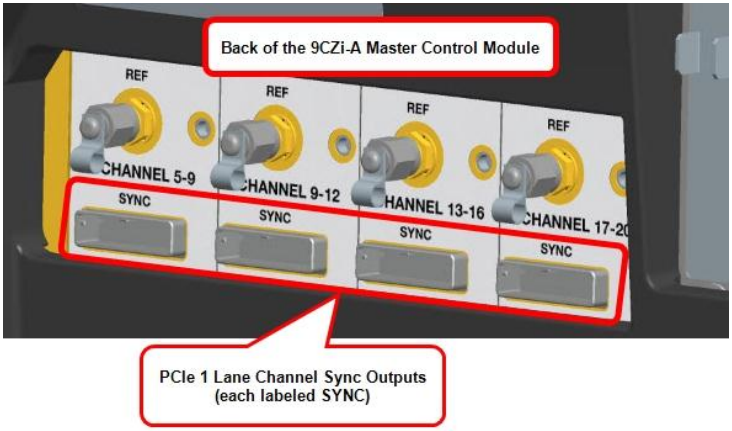
9CZi-A Master Control Module Configuration

This LabMaster configuration involves making **PCIe 1 and 4 Lane**, **DVI-D**, **SMA 72"**, and **Power Cable** connections. Follow these steps to properly connect all parts of your LabMaster setup.

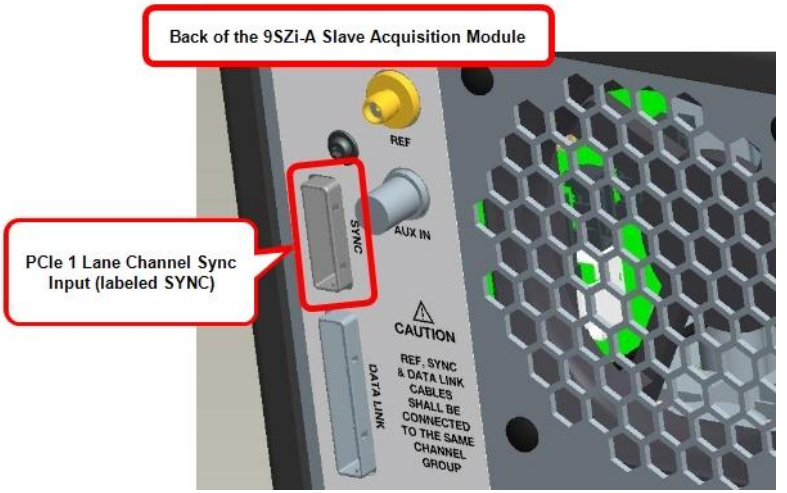
PCIe 1 Lane Cable - Master Control Module to Slave Acquisition Module SYNC Connection(s)

Connect each **PCIe 1 Lane Control Output** on the back of your **9CZi-A Master Control Module** to the **PCIe 1 Lane Input** on each **9xxSZi-A Slave Acquisition Module** used in your system using the **PCIe 1 Lane** cable(s) provided.

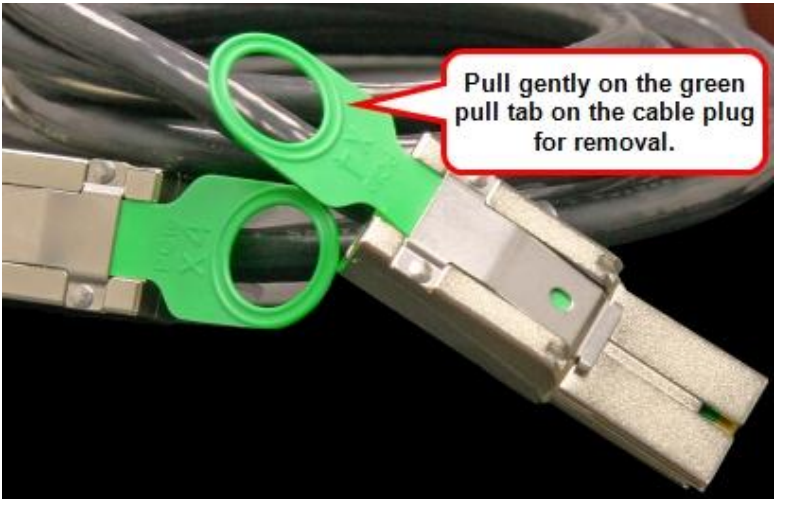
On the back of the **Master Control Module**, plug one end of the PCIe 1 Lane cable into the **PCIe 1 Lane Channel Sync Output** (labeled **SYNC**).



Now, on the back of the **Slave Acquisition Module**, connect the other end of the same PCIe 1 Lane cable into the corresponding **PCIe 1 Lane Channel Sync Input** (labeled **SYNC**).


Back of the 9SZi-A Slave Acquisition Module
PCIe 1 Lane Channel Sync Input (labeled SYNC)
REF
SYNC
AUX IN
CAUTION
DATA LINK
REF, SYNC & DATA LINK CABLES SHALL BE CONNECTED TO THE SAME CHANNEL GROUP

Gently pull the green tab on the cable plug to remove it.



Repeat the previous steps for every additional **Slave Acquisition Module** in your system.

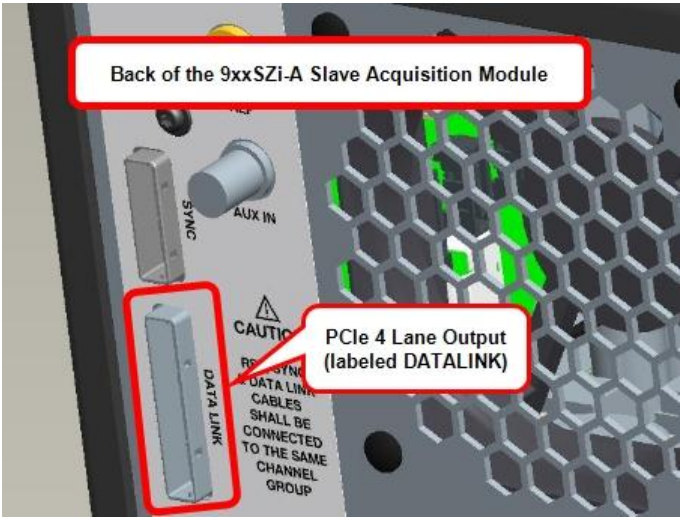
PLEASE NOTE THE FOLLOWING:

- PCIe 1 Lane Cable plugs are keyed with a single groove along one wide side of the plug. The plug must be inserted into the socket with the groove aligned properly.
- Connect into your Slave Acquisition Modules from the correct channel groupings on the 9CZi-A Master Control Module; meaning, your first Slave Acquisition Module is connected from the CHANNEL 1-4 output, second from the CHANNEL 5-9 output, third from the CHANNEL 9-12 output, fourth from the CHANNEL 13-16 output, and last from the CHANNEL 17-20 output.
- If you are connecting less than 5 of the Slave Acquisition Modules, the PCIe 1 Lane Channel Sync Outputs on the back of the Master Control Module may not be skipped and must be connected in consecutive order into the PCIe 1 Lane Channel Sync Inputs on the back of the corresponding slaves.

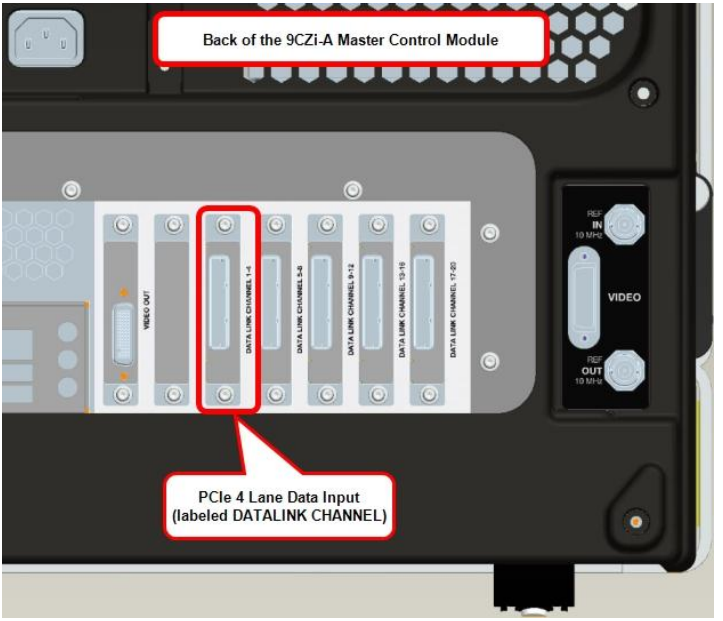
PCIe 4 Lane Cable - Slave Acquisition Module to Master Control Module SYNC Connection(s)

Now, let's continue making the PCI Express connections by cabling the **PCIe 4 Lane Data Output** on the back of each **9xxSZi-ASlave Acquisition Module** to the **PCIe 4 Lane Data Inputs** on the back of your **9CZi-AMaster Control Module** using **PCIe 4 Lane** cable(s) provided.

On the back of a **Slave Acquisition Module**, connect one end of a PCIe 4 Lane cable from the **PCIe 4 Lane Data Output** (labeled **DATALINK**).



Now, on the back of the **Master Control Module**, connect the other end of the same PCIe 4 Lane cable into the corresponding **PCIe 4 Lane Data Input** (labeled **DATALINK CHANNEL**).



Gently pull the green tab on the cable plug to remove it.

Repeat the previous steps for every additional **Slave Acquisition Module** in your system.

PLEASE NOTE THE FOLLOWING:

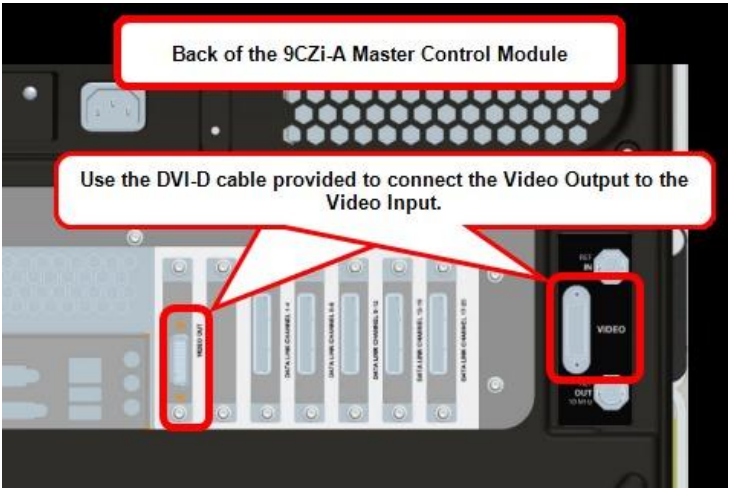
- PCIe 4 Lane Cable plugs are keyed with a single groove along one wide side of the plug. The plug must be inserted into the socket with the groove aligned properly.
- Be sure to connect from your Slave Acquisition Modules into the correct channel groupings on the 9CZi-A Master Control Module; meaning, your first Slave Acquisition Module is connected into DATALINK CHANNEL 1-4 input on the Master Control Module, second into the DATALINK CHANNEL 5-9 input, third into the DATALINK CHANNEL 9-12 input, fourth into the DATALINK CHANNEL 13-16 input, and last into the DATALINK CHANNEL 17-20 input.
- If you are connecting less than 5 of the Slave Acquisition Modules, the PCIe 4 Lane Data Inputs on the back of the Master Control Modulemay not be skipped and must be connected in consecutive order from the PCIe 4 Lane Data Outputs on the back of the corresponding slaves.

DVI-D Connection - Video Card to Touch-Screen Display on the Master Control Module

The **DVI-D Video Output** must be connected to the **DVI-D Video Input** (both on the back of the **Master Control Module**) using the provided DVI-D cable **for the touch-screen display to function**.

Connect one end of the provided DVI-D cable into the **DVI-D Video Output** on the back of the **Master Control Module**.

Now, connect the other end of the same DVI-D cable into the **DVI-D Video Input**, also on the back of the **Master Control Module**.



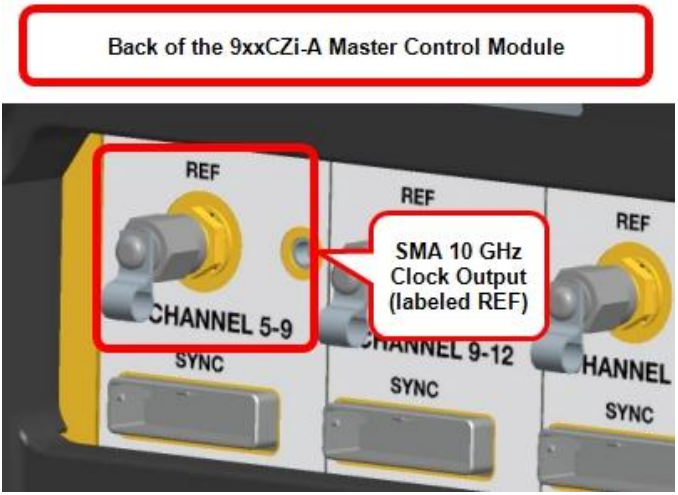
NOTE: The connections are specifically DVI-D.

SMA 72" Cables - Master Control Module to Slave Acquisition Module Connection(s) for Reference Clock

Connect each **SMA 10 GHz Clock Output** on the back of your **9CZi-A Master Control Module** to the **SMA 10 GHz Clock Input** on each **9xxSZi-A Slave Acquisition Module** used in your system using the **SMA 72"** cable(s) provided.

NOTE: Use an SMA torque wrench and ensure connections are properly tightened.

On the back of the **Master Control Module**, connect one end of an SMA 72" cable from a **SMA 10 GHz Clock Output** (labeled **REF**, unscrew the chain-linked 50 Ω termination, if necessary).



Now, on the back of the **Slave Acquisition Module**, connect the other end of the same SMA 72" cable into the corresponding **SMA 10 GHz Clock Input** (labeled **REF**).

Repeat the previous steps for every additional **Slave Acquisition Module** in your system.

Cap off any unused **SMA 10 GHz Clock Outputs** on the back of your 9CZi-A Master Control Module using the **chain-linked 50 Ω terminations** provided.

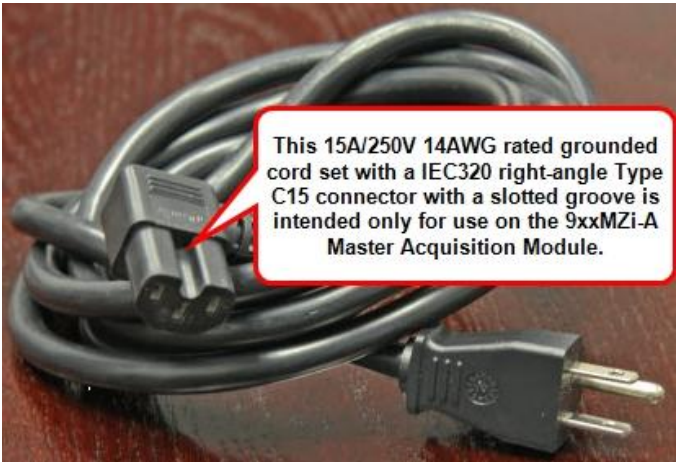
Power Cable Connections and Main Power Switch

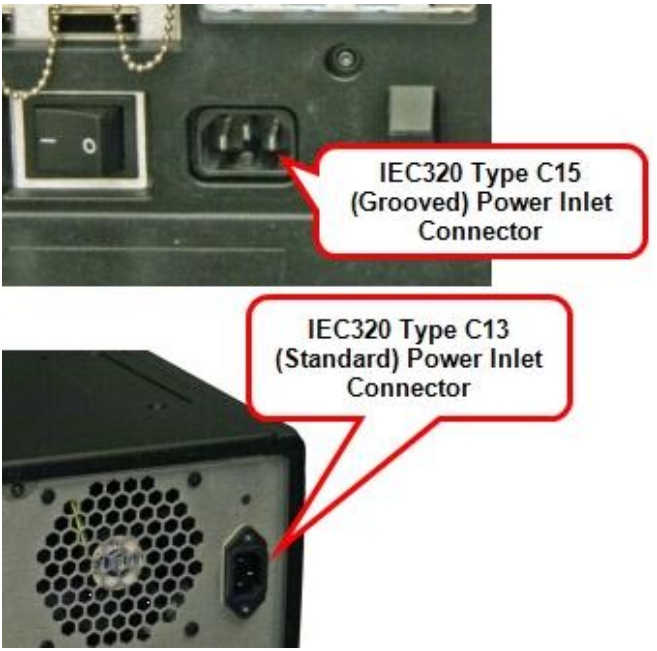
The combined draw from your **9CZi-A Master Control Module** and **9xxSZi-A Slave Acquisition Modules** (max of 5) approximately totals **5 kW**, Teledyne LeCroy advises that your power connections be generally divided as follows:

- The **Master Control Module** requires less power and may be combined with a **Slave Acquisition Module** to a different circuit rated to handle a combined **2050 Watts**.
- Connect any additional pairs of **Slave Acquisition Modules** to a different circuit rated to handle a combined **2050 Watts**.

A 15A/250V 14AWG rated grounded cord set with a IEC320 right-angle Type C15 connector with a slotted groove is provided specifically for the **Master Control Module**. Components other than the **Master Control Module** are each provided with a standard 10A/250V 18AWG rated grounded cord set with an IEC320 right-angle Type C13 connector. Ω

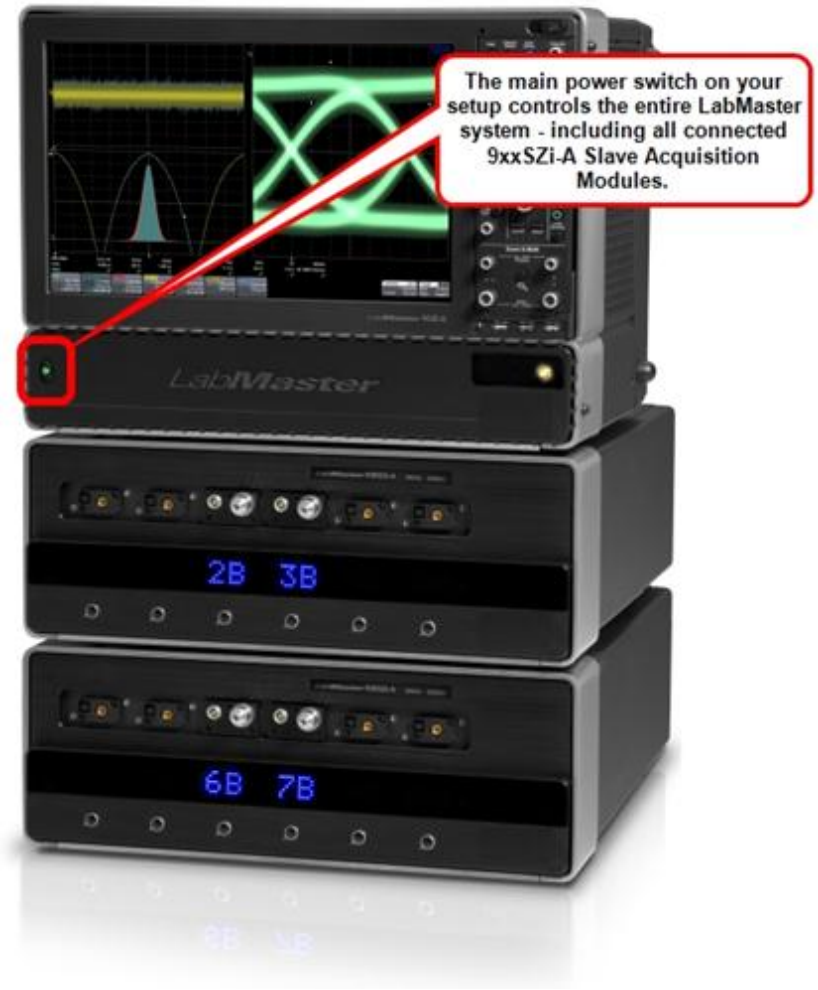
NOTE: Always refer to the product datasheet specifications at teledynelecroy.com for the most current and detailed power ratings.


This 15A/250V 14AWG rated grounded cord set with a IEC320 right-angle Type C15 connector with a slotted groove is intended only for use on the 9xxMZi-A Master Acquisition Module.



When all connections are made, the main switch on the front of the Master Control Module powers all connected items - Master and Slave Acquisition Module(s) - as a single LabMaster unit**.**

NOTE: If any connections are incorrect, the main power switch does not power on your system.


The main power switch on your setup controls the entire LabMaster system - including all connected 9xxSZi-A Slave Acquisition Modules.
LabMaster
2B 3B
6B 7B

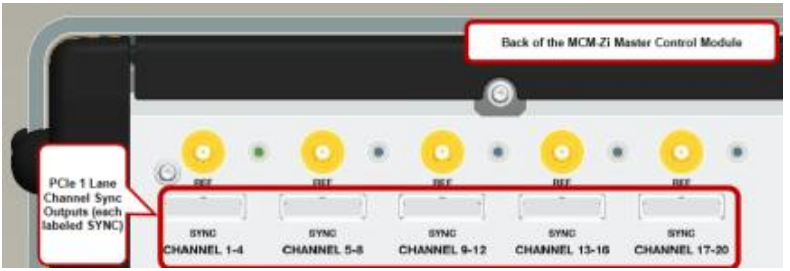
MCM-Zi Master Control Module Configuration

This LabMaster configuration involves making **PCIe 1 and 4 Lane**, **SMA 72"**, and **Power Cables**. Follow these steps to properly connect all parts of your LabMaster.

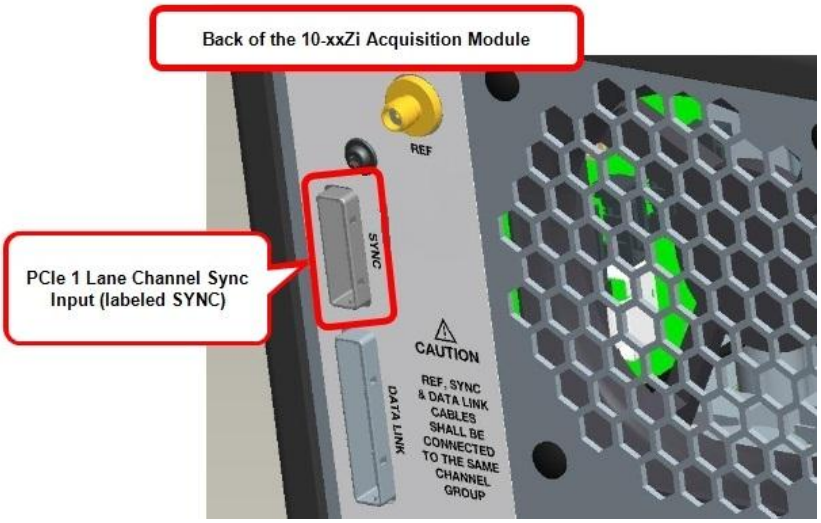
PCIe 1 Lane Cable SYNC Connection(s)

Connect each **PCIe 1 Lane Control Input** on the back of your 10-xxZi Acquisition Modules to a **PCIe 1 Lane Output** on the MCM-Zi Master Control Module using the **PCIe 1 Lane** cable(s) provided.

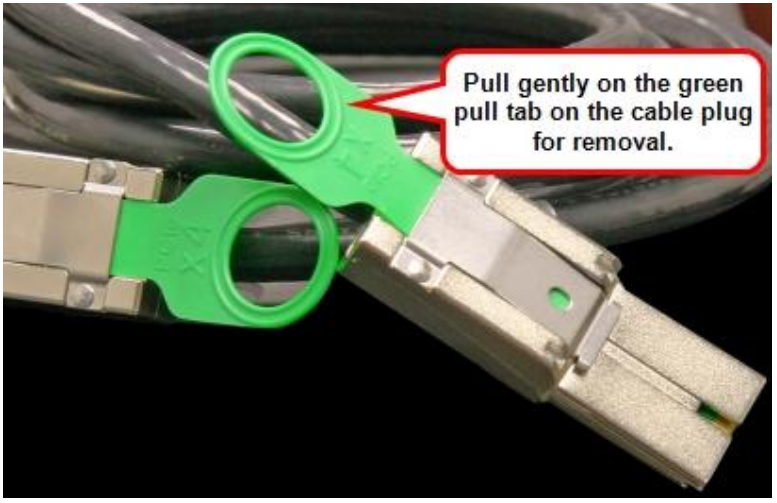
On the back of the Master Control Module, plug one end of the PCIe 1 Lane cable into the **PCIe 1 Lane Channel Sync Output** (labeled **SYNC**).



Now, connect the other end of the 1 Lane cable into the **SYNC** socket on the back of the Acquisition Module.


Back of the 10-xxZi Acquisition Module
PCIe 1 Lane Channel Sync Input (labeled SYNC)
REF
SYNC
DATA LINK
CAUTION
REF, SYNC & DATA LINK CABLES SHALL BE CONNECTED TO THE SAME CHANNEL GROUP

Gently pull the green tab on the cable plug to remove it.



Repeat these steps for every additional Acquisition Module in your system.

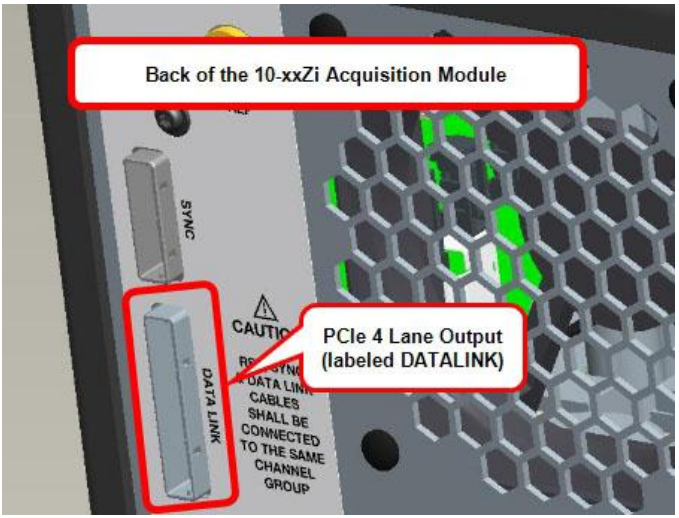
PLEASE NOTE THE FOLLOWING:

- PCIe 1 Lane Cable plugs are keyed with a single groove along one wide side of the plug. The plug must be inserted into the socket with the groove aligned properly.
- Connect into your Acquisition Modules from the correct channel groupings on the Master Control Module; meaning, your first Acquisition Module is connected from the CHANNEL 1-4 output, second from the CHANNEL 5-8 output, third from the CHANNEL 9-12 output, etc.
- If you are connecting less than 5 of the Acquisition Modules, the PCIe 1 Lane Channel Sync Outputs on the back of the Master Control Module may not be skipped and must be connected in consecutive order into the PCIe 1 Lane Channel Sync Inputs on the back of the corresponding acquisition modules.

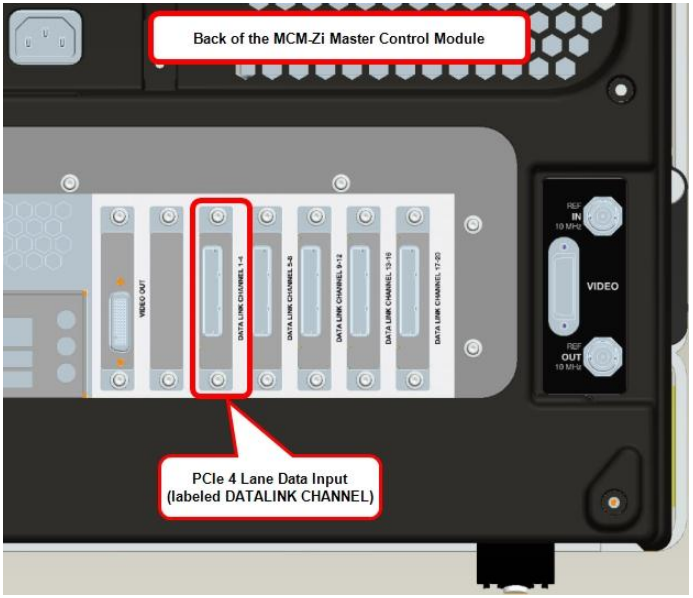
PCIe 4 Lane DATALINK Connection(s)

Continue making the PCI Express connections by cabling the **PCIe 4 Lane Data Output** on the back of each 10-xxZi Acquisition Module to the **PCIe 4 Lane Data Inputs** on the back of your MCM-Zi Master Control Module using **PCIe 4 Lane** cable(s) provided.

On the back of the Acquisition Module, connect one end of a PCIe 4 lane cable from the **PCIe 4 Lane Data Output** (labeled **DATALINK**).



Now, on the back of the Master Control Module, connect the other end of the same PCIe 4 Lane cable into the corresponding **PCIe 4 Lane Data Input** (labeled **DATALINK CHANNEL**).



Gently pull the green tab on the cable plug to remove it.

Repeat the previous steps for every additional Acquisition Module in your system.

PLEASE NOTE THE FOLLOWING:

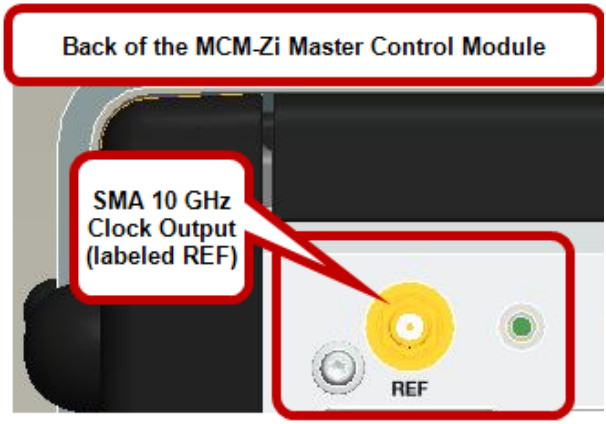
- PCIe 4 Lane Cable plugs are keyed with a single groove along one wide side of the plug. The plug must be inserted into the socket with the groove aligned properly.
- Be sure to connect your Acquisition Modules to the correct channel groupings on the Master Control Module; First Acquisition Module is connected into DATALINK CHANNEL 1-4, second into the DATALINK CHANNEL 5-9 input, third into the DATALINK CHANNEL 9-12 input, fourth into the DATALINK CHANNEL 13-16 input, and last into the DATALINK CHANNEL 17-20 input.
- If you are connecting less than 5 of the Slave Acquisition Modules, the PCIe 4 Lane Data Inputs on the back of the Master Control Module may not be skipped and must be connected in consecutive order from the PCIe 4 Lane Data Outputs on the back of the corresponding slaves.

SMA 72" Cables - ChannelSync Clock Connections

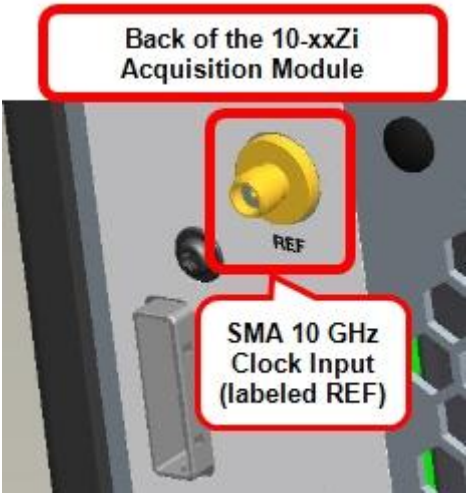
Connect each **SMA 10 GHz Clock Output** on the back of your MCM-Zi Master Control Module to the **SMA 10 GHz Clock Input** on each 10-xxZi Acquisition Module used in your system using the **SMA 72" Male to Male** cable(s) provided.

NOTE: Use an SMA torque wrench and ensure connections are properly tightened.

On the back of the Master Control Module, connect one end of an SMA 72" cable from a **SMA 10 GHz Clock Output** (labeled **REF**, unscrew the chain-linked 50 Ω termination, if necessary).



Now, on the back of the Acquisition Module, connect the other end of the same SMA 72" cable into the corresponding **SMA 10 GHz Clock Input** (labeled **REF**).



Repeat the previous steps for every additional Acquisition Module in your system.

Cap off unused **SMA 10 GHz Clock Outputs** on the back of your Master Control Module using the **chain-linked 50 Ω terminations** provided.

Power Cable Connections and Main Power Switch

Teledyne LeCroy advises that you note the power ratings of the individual modules and connect them to suitably rated circuits.

- MCM-Zi Control Module comes with an IEC60320 Type C13 power inlet connector.
- 9xxSZi-A Acquisition Module comes with an IEC60320 Type C20 power inlet connector.

Always refer to the product datasheet at www.teledynelecroy.com for the most current and detailed specifications regarding power ratings.

CAUTION: The combined draw from your Master Control Module and Acquisition Modules (max of 20) can be many kilowatts. Two acquisition modules connected to a single circuit may cause an overcurrent condition for that circuit.

When all connections are made, the main power switch on the front of the **Master Control Module** powers on all components as a single unit.

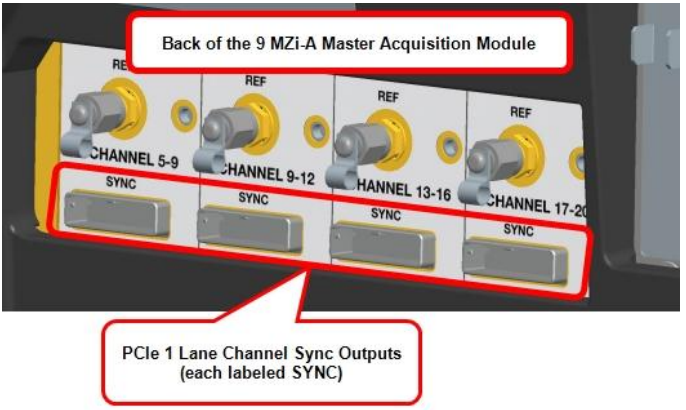
NOTE: If any connections are incorrect, the main power switch will not power on the system.

9xxMZi-A Master Acquisition Module Configuration

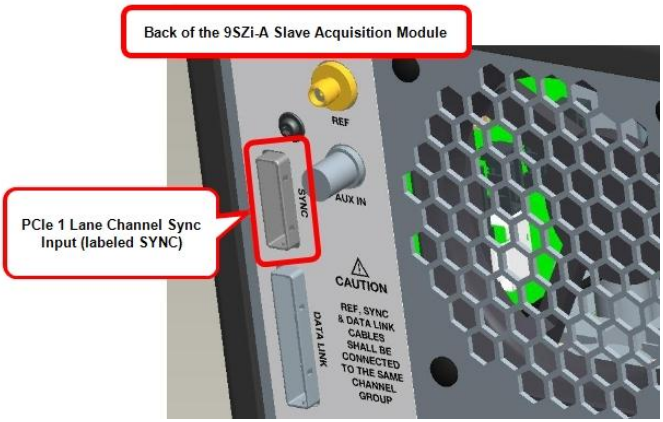
PCIe 1 Lane Cable - Master Acquisition Module to Slave Acquisition Module

Connect each **PCIe 1 Lane Control Output** on the back of your **9xxMZi-A Master Acquisition Module** to the **PCIe 1 Lane Input** on each **9xxSZi-A Slave Acquisition Module** used in your system using the **PCIe 1 Lane** cable(s) provided.

On the back of the **Master Acquisition Module**, plug one end of the PCIe 1 Lane cable into the **PCIe 1 Lane Channel Sync Output** (labeled **SYNC**).



Now, connect the other end of the 1 Lane cable into the **SYNC** socket on the back of the **9 SZi-A (Slave)**.


Back of the 9SZi-A Slave Acquisition Module
REF
AUX IN
SYNC
PCIe 1 Lane Channel Sync Input (labeled SYNC)
CAUTION
REF, SYNC & DATA LINK CABLES SHALL BE CONNECTED TO THE SAME CHANNEL GROUP
DATA LINK

Gently pull the green tab on the cable plug to remove it.

Repeat the previous steps for every additional **Slave Acquisition Module** in your system.

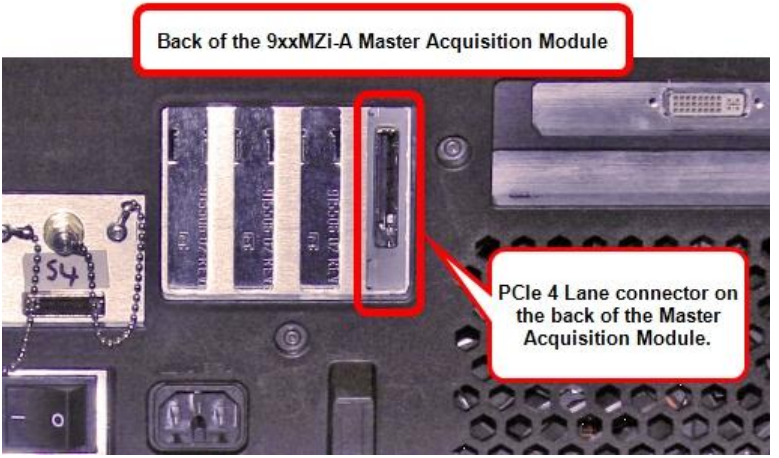
PLEASE NOTE THE FOLLOWING:

- PCIe 1 Lane Cable plugs are keyed with a single groove along one wide side of the plug. The plug must be inserted into the socket with the groove aligned properly.
- Connect into your Slave Acquisition Modules from the correct channel groupings on the 9xxMZi-A Master Acquisition Module; meaning, your first Slave Acquisition Module is connected from the CHANNEL 5-9 output, second from the CHANNEL 9-12 output, third from the CHANNEL 13-16 output, and last from the CHANNEL 17-20 output.
- If you are connecting less than 4 of the Slave Acquisition Modules, the PCIe 1 Lane Channel Sync Outputs on the back of the Master Acquisition Module may not be skipped and must be connected in consecutive order into the PCIe 1 Lane Channel Sync Inputs on the back of the corresponding slaves.

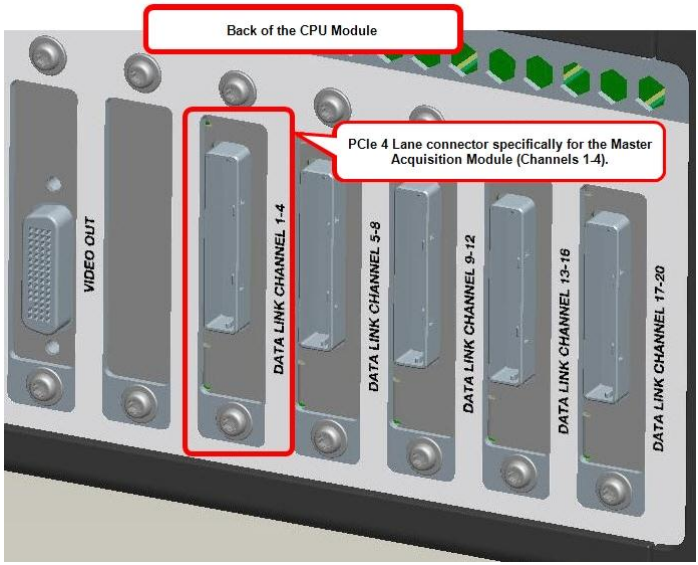
PCIe 4 Lane Cable - CPU Module to Master Acquisition Module

Make a connection for Channels 1-4 from the back of the **Master Acquisition Module** into the **PCIe 4 Lane Data Input** (labeled **DATALINK CHANNEL 1-4**) on the back of the **CPU Module**.

Connect one end of a PCIe 4 Lane cable to the **PCIe 4 Lane Data Output** (labeled **DATALINK CHANNEL 1-4**) on the back of the **Master Acquisition Module**.



Now, on the back of the **CPU Module**, connect the other end of the same PCIe 4 Lane cable specifically into the **PCIe 4 Lane Data Input** (labeled **DATALINK CHANNEL 1-4**).


Back of the CPU Module
PCIe 4 Lane connector specifically for the Master Acquisition Module (Channels 1-4).
VIDEO OUT
DATA LINK CHANNEL 1-4
DATA LINK CHANNEL 5-8
DATA LINK CHANNEL 9-12
DATA LINK CHANNEL 13-16
DATA LINK CHANNEL 17-20

9xxSZi-ASlave Acquisition Modules connections for channels above 1-4, connections are made from the **PCIe 4 Lane Data Output** (labeled **DATALINK CHANNEL**) on the back of each **Slave Acquisition Module** into the corresponding **PCIe 4 Lane Data Input** (labeled **DATALINK CHANNEL**) on the back of the **CPU Module**.

Gently pull the green tab on the cable plug to remove it.

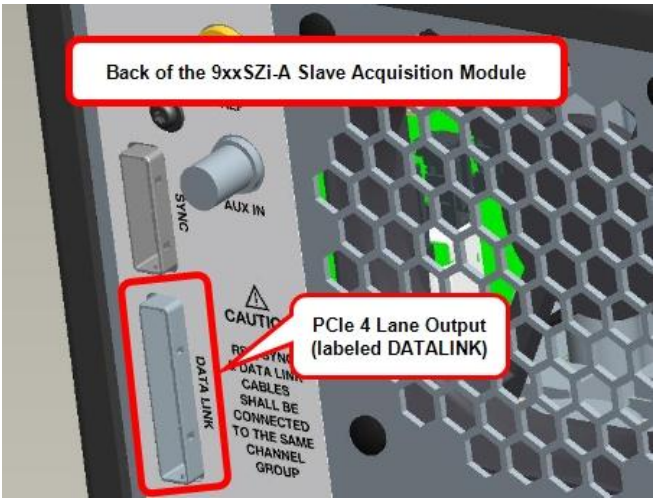
PLEASE NOTE THE FOLLOWING:

- PCIe 4 Lane Cable plugs are keyed with a single groove along one wide side of the plug. The plug must be inserted into the socket with the groove aligned properly.
- If you are connecting less than 4 of the Slave Acquisition Modules, the PCIe 4 Lane Data Inputs on the back of the CPU Modulemay not be skipped and must be connected in consecutive order from the PCIe 4 Lane Data Outputs on the back of the corresponding slaves.

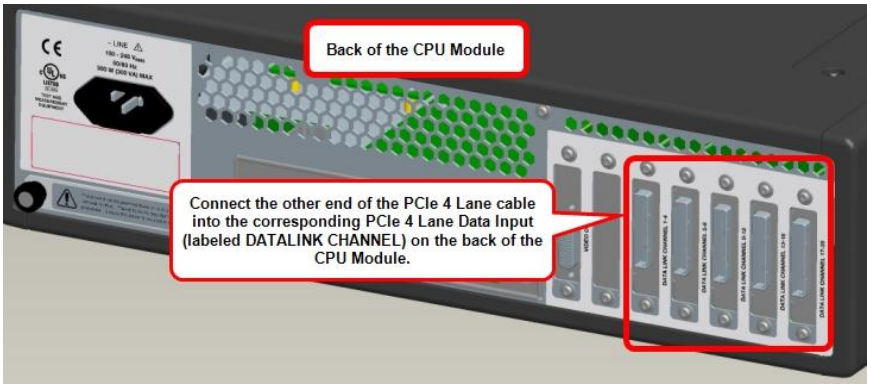
PCIe 4 Lane Cable - Slave Acquisition Module to CPU Module

Continue making the PCI Express connections for channels above 1-4, by cabling the **PCIe 4 Lane Data Output** on the back of each **9xxSZi-ASlave Acquisition Module** to the **PCIe 4 Lane Data Inputs** on the back of your **CPU Module** using **PCIe 4 Lane** cable(s) provided.

Plug one end of a PCIe 4 Lane cable into the **PCIe 4 Lane Data Output** (labeled **DATALINK**) on the back of each **Slave Acquisition Module**.



Now, on the back of the **CPU Module**, connect the other end of the same PCIe 4 Lane cable into the corresponding **PCIe 4 Lane Data Input** (labeled **DATALINK CHANNEL**).


Back of the CPU Module
Connect the other end of the PCIe 4 Lane cable into the corresponding PCIe 4 Lane Data Input (labeled DATALINK CHANNEL) on the back of the CPU Module.

Gently pull the green tab on the cable plug to remove it.

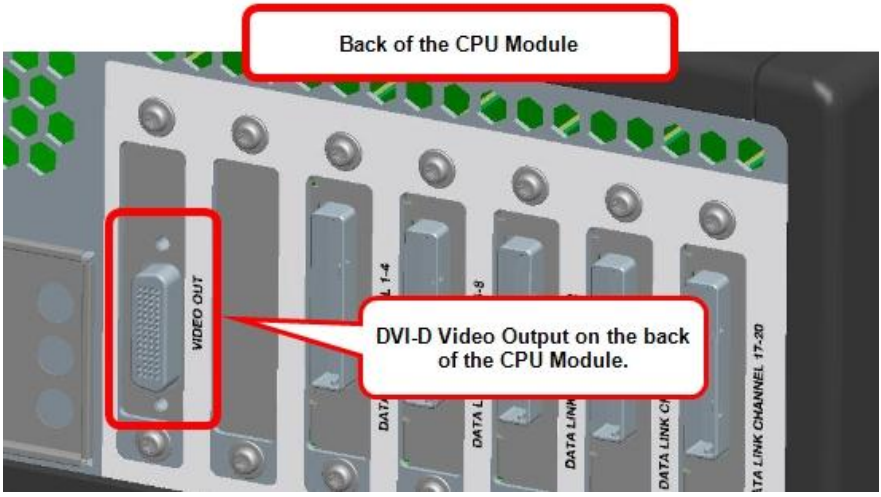
PLEASE NOTE THE FOLLOWING:

- PCIe 4 Lane Cable plugs are keyed with a single groove along one wide side of the plug. The plug must be inserted into the socket with the groove aligned properly.
- If you are connecting less than four of the Slave Acquisition Modules, the PCIe 4 Lane Data Inputs on the back of the CPU Modulemay not be skipped and must be connected in consecutive order from the PCIe 4 Lane Data Outputs on the back of the corresponding slaves.

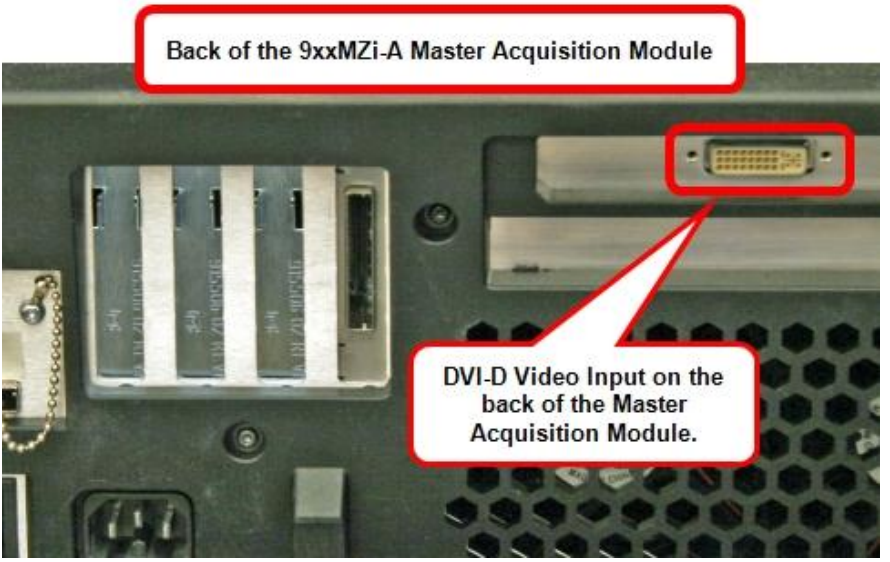
DVI-D Connection - CPU Module's Video Card Output to the Master Acquisition Module's Touch-Screen Display Video Input

Connect the **CPU Module's** Video Card **DVI-D Output** into the **Master Acquisition Module's** Touch-Screen Display **DVI-D Input** using the DVI-D cable provided.

Connect one end of the provided DVI-D cable into the **DVI-D Video Output** on the back of the **CPU Module**.



Now, connect the other end of the same DVI-D cable into the **DVI-D Video Input** on the back of the **Master Acquisition Module**.



NOTE: The connections are specifically DVI-D.

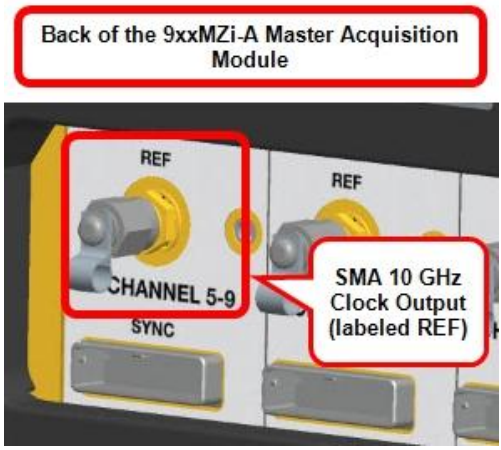
SMA 72" Cables - Master Acquisition Module to Slave Acquisition Module Reference Clock Connection

Connect each **SMA 10 GHz Clock Output** on the back of your **9xxMZi-A Master Acquisition Module** to the **SMA 10 GHz Clock Input** on each **9xxSZi-A Slave Acquisition Module** used in your system using the **SMA 72"** cable(s) provided.

NOTE: Use an SMA torque wrench and ensure connections are properly tightened.

SMA 72" M to M Cable

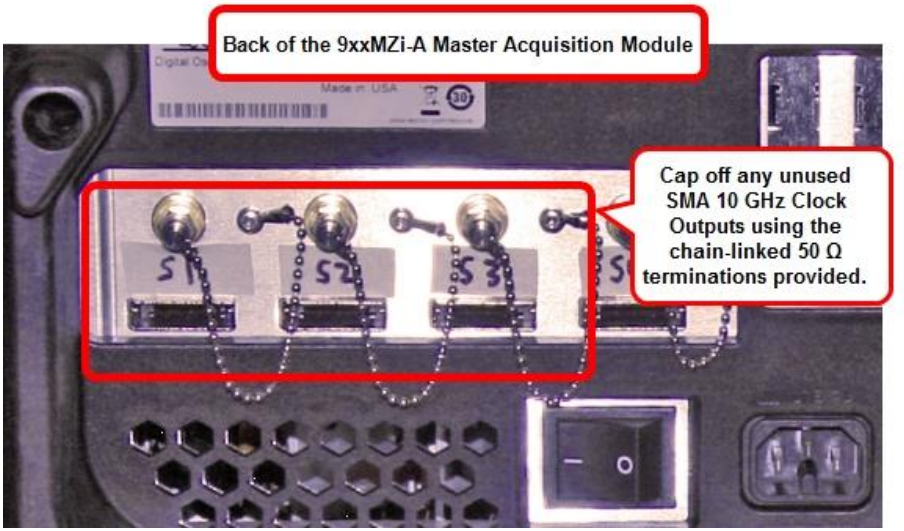
On the back of the **Master Acquisition Module**, connect one end of an SMA 72" cable from a **SMA 10 GHz Clock Output** (labeled **REF**, unscrew the chain-linked 50 Ω termination, if necessary).



Now, on the back of the **Slave Acquisition Module**, connect the other end of the same SMA 72" cable into the corresponding **SMA 10 GHz Clock Input** (labeled **REF**).

Repeat the previous steps for every additional **Slave Acquisition Module** in your system.

Cap off any unused **SMA 10 GHz Clock Outputs** on the back of your 9xxMZi-A Master Acquisition Module using the **chain-linked 50 Ω terminations** provided.


Back of the 9xxMZi-A Master Acquisition Module
Cap off any unused SMA 10 GHz Clock Outputs using the chain-linked 50 Ω terminations provided.

Power Cable Connection and Main Power Switch

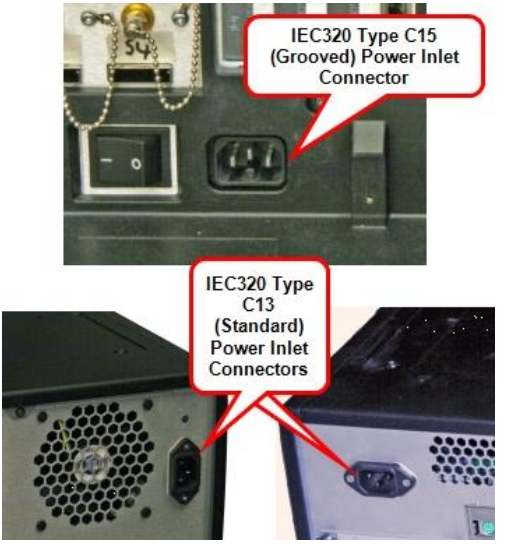
The combined draw from your **9xxMZi-AMaster Acquisition Module**, **9xxSZi-ASlave Acquisition Modules** (max of 4), and **CPU Module** approximately totals **5 kW**, Teledyne LeCroy advises that your power connections be generally divided as follows:

- Connect the **Master Acquisition Module** and its **CPU Module** to a single circuit rated to handle a combined **1250 Watts**.
- Connect any additional pairs of **Slave Acquisition Modules** to a different circuit rated to handle a combined **2050 Watts**.

NOTE: Always refer to the product datasheet specifications at teledynelecroy.com for the most current and detailed power ratings.

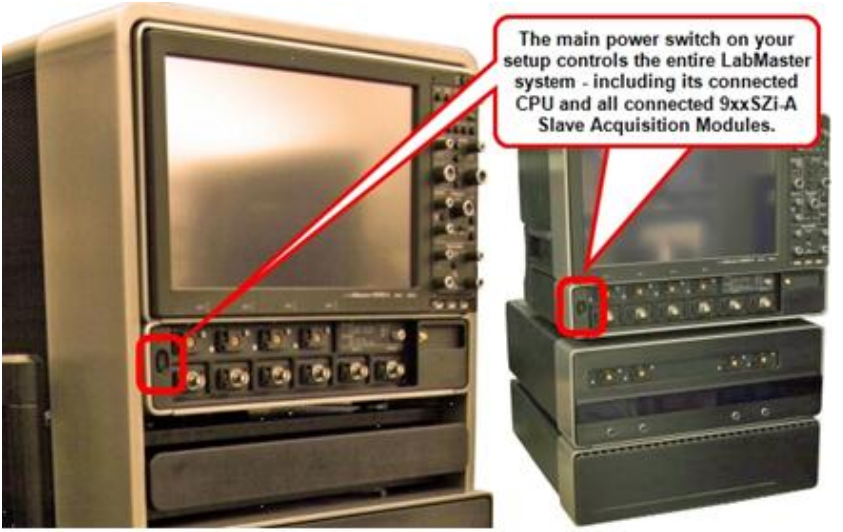
15A/250V 14AWG rated grounded cord set with a IEC320 right-angle Type C15 connector with a slotted groove is provided specifically for the **Master Acquisition Module**. Components other than the **Master Acquisition Module** are each provided with a standard 10A/250V 18AWG rated grounded cord set with an IEC320 right-angle Type C13 connector.

This 15A/250V 14AWG rated grounded cord set with a IEC320 right-angle Type C15 connector with a slotted groove is intended only for use on the 9 CZi-A Master Control Module.



When all connections are made, the **Standby Power** switch on the front of the **Master Acquisition Module** powers all connected items (Master Acquisition, Slave Acquisition, and CPU Module) as a single LabMaster unit.

NOTE: If any connections are incorrect, the main power switch does not power on your system.


The main power switch on your setup controls the entire LabMaster system - including its connected CPU and all connected 9xxSZi-A Slave Acquisition Modules.

Removing and Attaching the Front Panel Control

Detach the **Front Panel Control** from the oscilloscope by sliding the detachment lever to the left and pulling at the right.

Attach the front panel by inserting the lower part first, sliding the detachment lever to the left, and then pushing the top in place.

Front Panel as a Remote Control

While detached, your front panel (standard or 4 channel version) can be used as a remote control. Just plug-and-play connect to the oscilloscope using the **USB - A** to **USB - Mini B** cable provided.

NOTE: While a standard front panel comes with your Zi oscilloscope, Teledyne LeCroy offers additional standard front panels or a 4 channel version (as follows) to better suit the way you work.

Touch Screen and External Displays

Set Up Internal Display

Connect the **DVI-D Video Output on the CPU** to the **DVI-D Video Input on the 9xxMZi-A Master Acquisition Module** to enable the internal, built-in touch-screen display. The 9CZi-A Master Control Module has the same display capabilities as the 9xxMZi-A Master Acquisition Module, except there is no separate CPU module. Instead, a short "jumper" cable connects video output to input. The MCM-Zi Master Control Module does not require any internal display set up.

Set Up External Display

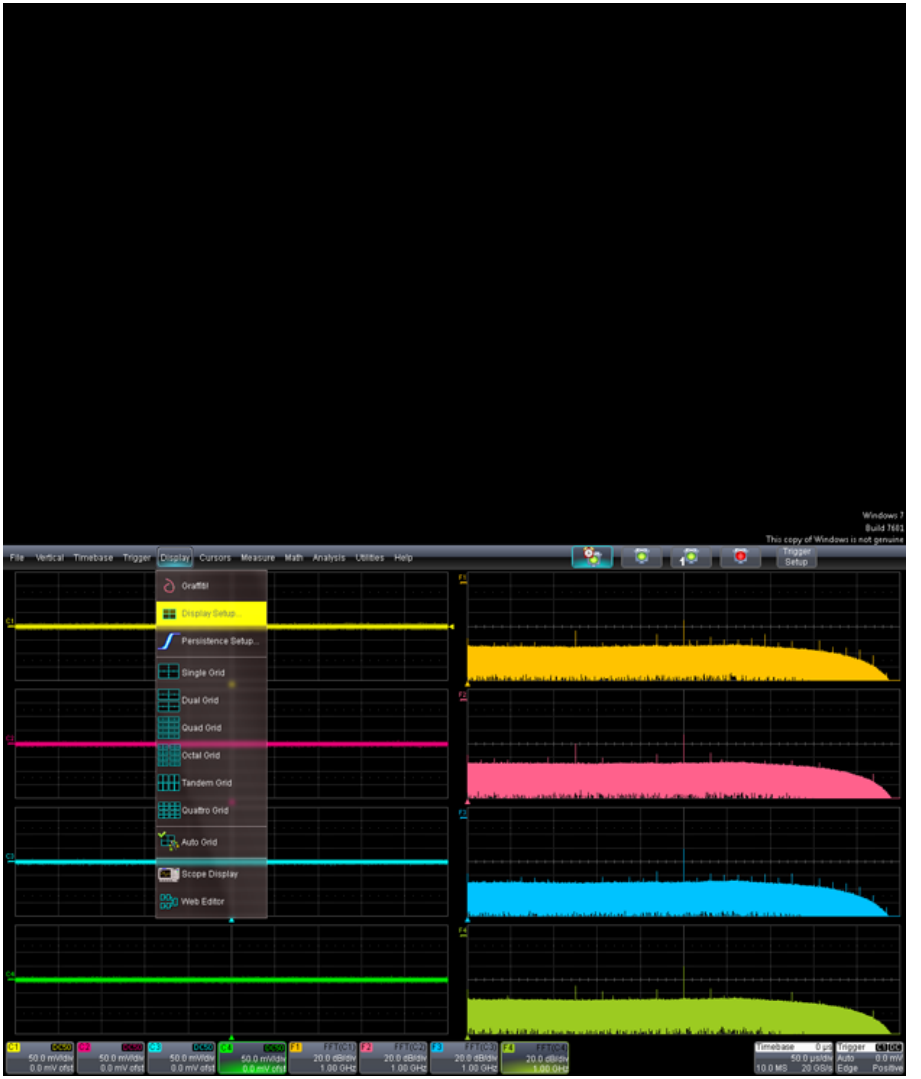
You may operate the instrument using the built-in touch-screen or attach an external monitor for extended display. A properly configured external display will take on all the touch-screen capabilities of the internal display.

NOTE: LabMaster 9xxMZi-A and 9CZi-A **do not** support extended desktop mode when connected to an external monitor. LabMaster MCM-Zi **does** support extended desktop mode. If the external monitor uses a Fujitsu touch screen driver, it will not work as a touch screen but will support extended display.

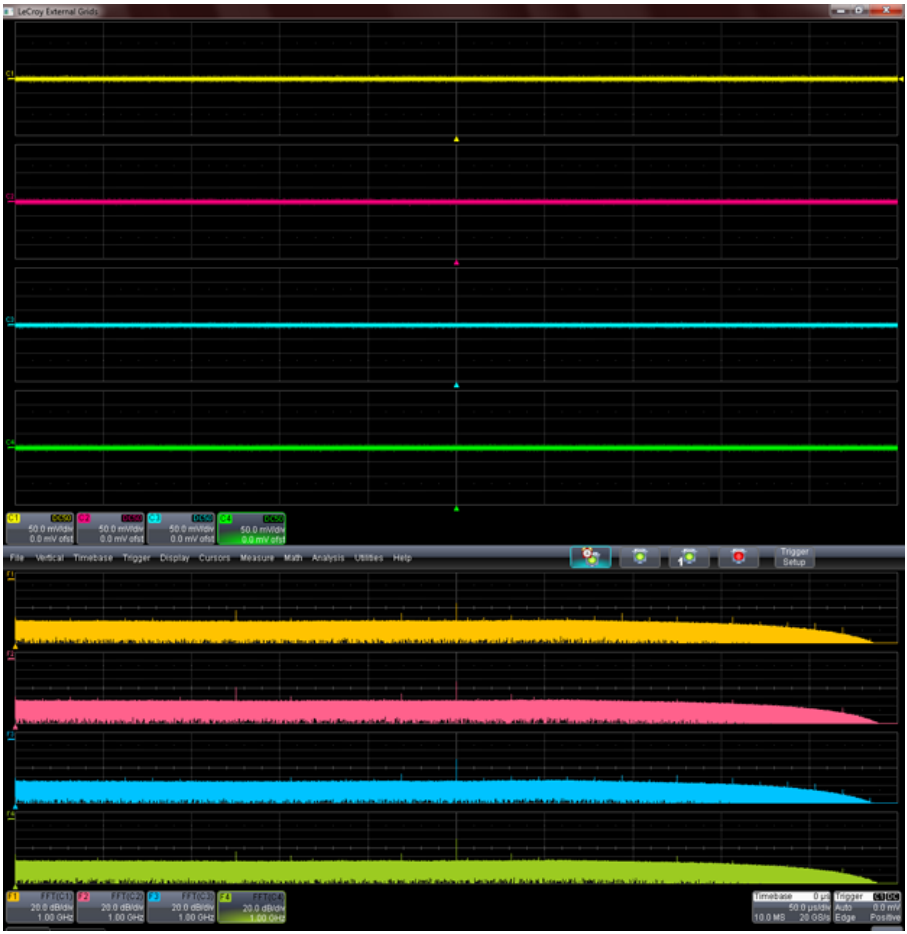
To connect to an external monitor:

1. Choose **File > Exit** to close the oscilloscope application so that the Windows desktop is visible (you do not need to shut down completely).
2. Connect the oscilloscope to the external monitor from the **DVI-D video output** connector.
3. Right-click on the desktop to display the settings menu, then choose **Screen Resolution**.
4. On the Windows display dialog:
    - Select display number 2 (the external monitor) and choose **Multiple displays: Extend this display**.
    - Drag the display number 2 icon to its location in your setup (above or below the oscilloscope display).
    - Make any other desired display selections, then touch **Apply** and **OK**.

5. Use the **Start DSO desktop icon** to restart the oscilloscope application.
6. Choose **Display > Display Setup**.
7. On the Display setup dialog, check **Extend Grids on 2nd Monitor**. The total number of grids is now distributed over both displays.



Both displays before Dual Display Mode selection. In this example, the top monitor is the external display.



Grids distributed after Dual Display Mode selection. Trace descriptor boxes move with the trace (note the movement of C1-C4). Other controls remain on the primary display (Display 1, which in this example is the bottom, internal display).

Signal Inputs

Interfaces

LabMaster 9 Zi systems are equipped with a variety of interfaces to allow you to connect cables directly to the oscilloscope channels, reducing the need to use costly adapters that may be easily lost or misplaced.

The interfaces power the probe and completely integrate the probe with the oscilloscope channel in a number of ways:

- Upon connection, the probe is recognized and some setup information, such as input coupling and attenuation, is performed automatically.
- System (probe plus oscilloscope) gain settings are automatically calculated and displayed based on the probe attenuation.
- Most active probes match probe to oscilloscope response automatically using probe response data stored in an on-board EEPROM. This ensures the best possible combined probe plus oscilloscope channel frequency response without the need to perform any de-embedding procedure.

Interfaces differ in bandwidth capabilities, so the interfaces contained on your oscilloscope—and their exact location—depend on the bandwidth rating of the oscilloscope model you purchased.

High-bandwidth interfaces (45 GHz and up) must be enabled by selecting the appropriate **Dual Bandwidth Interleave** setting on the Timebase dialog and the **Input B** setting on the Channel dialog.

NOTE: AUX INPUT and AUX OUTPUT connections are typically located on the Front of the oscilloscope near the other interfaces.

ProLink Interface

All LabMaster **9xxMZi-A Master Acquisition Modules** and **9xxSZi-A Slave Acquisition Modules** use the ProLink interface for inputs up to 20 GHz on channels 1-4.

The ProLink interface contains a 6-pin power and communication connection and a Blind Mate Adapter (BMA) signal connection to the probe. It offers 50 Ω input impedance and provides probe power and

control for a wide range of probes with bandwidth ratings from 3 GHz to 20 GHz. The nature of the ProLink interface with its recessed BMA connector means that an adapter must be connected to the ProLink interface to allow SMA or 2.92/K connector terminated cables to be attached to the oscilloscope channel. These adapters are normally provided with your oscilloscope, and are described in **ProLink Interface Adapters** (on page 67).

ProBus Interface

LabMaster **9xxMZi-A Master Acquisition Modules rated to 20 GHz** use the ProBus interface for inputs up to 25 GHz on channels 1-4.

LabMaster **945MZi-A Master Acquisition Modules** use the ProBus interface for inputs up to 25 GHz on channels 1 and 4, input B.

The ProBus interface contains a 6-pin power and communication connection and a BNC signal connection to the probe. It offers both 50 Ω/1 MΩ input impedance and provides probe power and control for a wide range of probes such as high impedance passive probes, high impedance active probes, current probes, high voltage probes, and differential probes. ProBus also includes sense rings for detecting passive probes. The ProBus interface may also have a BNC-terminated cable connected directly to it.

ProBus is based on a BNC connector and, depending on the exact BNC connector used and the oscilloscope design, is rated for up to 4 GHz with 50 Ω coupling or up to 1 GHz for 1 MΩ coupling (depending on the exact model purchase).

2.92 mm Interface

LabMaster **930SZi-A Slave Acquisition Modules** use the 2.92 mm interface for inputs up to 36 GHz on channels 2 and 3, input B.

LabMaster **945MZi-A Master Acquisition Modules** and **945SZi-A Slave Acquisition Modules** use the 2.92 mm interface for inputs up to 36 GHz on channel 2, input B.

This interface consists of a precision connector and a LEMO power and communication connector. It offers 50 Ω input impedance only.

The 2.92 mm high-bandwidth electrical paths are comprised of two connector halves/subassemblies which have a common mating interface:

- The first connector half is **mounted** onto the oscilloscope connector panel. The outer end of this connector has a

combination of grooves, external threads and a coaxial interface with a 2.92 mm airline geometry.

- The second connector half is the **connector saver**. It has a similar interface on one end, with spring-biased inner and outer contacts.

The connector saver has projections which interlock with slots on the mounted connector and a coupling nut which secures the two halves; resulting in a non-rotational, torque independent electrical connection. The spring-biased inner and outer contacts eliminate the need for specifying proof torque and no tools are required to mate or un-mate the connection.

The connector saver is easily field replaceable, should damage occur, making it a more field reliable system. The 2.92 mm connector savers operate mode free well beyond 36 GHz.

2.4 mm Interface

LabMaster **945MZi-A Master Acquisition Modules** and **945SZi-A Slave Acquisition Modules** use the 2.4 mm interface 25 - 45 GHz inputs on channel 3, input B. This interface consists of a precision connector and a LEMO power and communication connector. It offers 50 Ω input impedance only.

The 2.4 mm high-bandwidth electrical paths are comprised of two connector halves/subassemblies which have a common mating interface:

- The first connector half is **mounted** onto the oscilloscope connector panel. The outer end of this connector has a combination of grooves, external threads and a coaxial interface with a 2.4 mm airline geometry.

- The second connector half is the **connector saver**. It has a similar interface on one end, with spring-biased inner and outer contacts.

The connector saver has projections which interlock with slots on the mounted connector and a coupling nut which secures the two halves; resulting in a non-rotational, torque independent electrical connection. The spring-biased inner and outer contacts eliminate the need for specifying proof torque and no tools are required to mate or un-mate the connection.

The connector saver is easily field replaceable, should damage occur, making it a more field reliable system. The 2.4 mm connector saver operates mode free well beyond 45 GHz.

NOTE: The mounted connectors for the 2.92 mm and 2.4 mm interfaces look identical, and the connector savers look very similar, so be sure to attach the correct connector saver to achieve the desired bandwidth. The 2.92 mm connector saver will fit over the 2.4 mm mounted connector (and vice versa) but will not yield the full 45 GHz bandwidth.

ProLink Interface Adapters

Teledyne LeCroy's ProLink Adapters (LPA) provides the ability to connect a cable to your oscilloscope that is either BNC, SMA, or K (2.92 mm) terminated. These adapters are only for cable connection since they do not provide the power and communication interfaces required for probe usage. In fact, the absence of these connections on the adapters means that a probe cannot be connected to the oscilloscope when one of these adapters is connected.

The following cable connections are supported:

- BNC, using the LPA-BNC Blind Mate Adapter (BMA) to BNC interface adapter. This is not normally provide with your oscilloscope, but may be ordered as an accessory.
- SMA , using the LPA-SMA BMA-to-SMA adapter
- K-Type (2.92 mm), using the LPA-K BMA-to-2.92 mm adapter (4 are sent standard in 13 - 45 GHz units).

BMA-to-SMA, BMA-to-BNC, BMA-to-2.92 mm ProLink Adapters.

First, the BMA Female Connector (1). Then, shown installed are the ProLink LPA-SMA, LPA-BNC, and LPA-K Adapters (2, 3, and 4).

NOTE: When connecting an active probe to the instrument, an adapter is not required unless you wish to connect a ProBus compatible probe to a ProLink input.

Connecting the Adapters

The mating end of the ProLink adapter has four fastening clips (shown right).

When installing an adapter on the instrument's connector panel, align the male 6-pin connector with the female connector and push the adapter straight forward. You are likely to notice some resistance and hear clicks as the four clips snap into place. Now, tighten the captive screws.

When removing an adapter, loosen the two captive screws. Push down on the adapter to unseat the clips. This requires some force and is initially noisy; however, no damage results to the connector, the floating female BMA connector, or the pins, as they can accommodate 15 degrees off axis while mated or unmated.

ProLink Probe Adapters

ProLink Probe Adapters differ from ProLink Interface Adapters in that they contain a probe power and communication pass-through that the interface adapters do not have.

Currently, only one probe adapter is available, the LPA-2.92 mm. This device is used to allow attachment of a probe platform/cable assembly

designed for connection to a 2.92 mm Probe Connection Interface to be connected to a ProLink input connection. For instance, this could be used to connect a 25 GHz probing system using 2.92 mm and LEMO connections for connection to a ProLink input.

Connecting the ProLink Probe Adapter is done in a similar way as connecting a ProLink Interface Adapter.

Probe Dialog

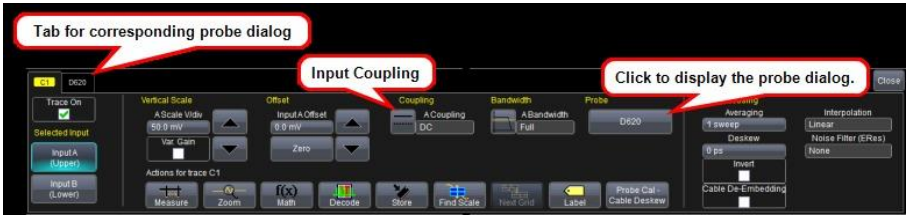
Teledyne LeCroy proprietary probe interfaces provide a complete measurement solution from probe tip to oscilloscope display. The Probe Dialog displays probe attenuation and other information, and allows you to make tip select and other probe settings from the oscilloscope touchscreen.

The following figure shows a typical channel dialog on a Teledyne LeCroy oscilloscope containing both ProLink (Input A, Upper) and ProBus (Input B, Lower) interfaces. The input selection is on the left-hand side of the dialog box.

When the probe is not connected, there is only a C1 tab selection for vertical channel setup and the user has the ability to select input coupling and probe attenuation.

Channel dialog showing Input A's interface controls setup before connection.

After a probe is connected, it is recognized and an additional tab with the probe model name is displayed to the right of the C1 tab. Click on the tab or the probe field to display the probe dialog.



Channel dialog showing Input A's interface controls setup after connection.

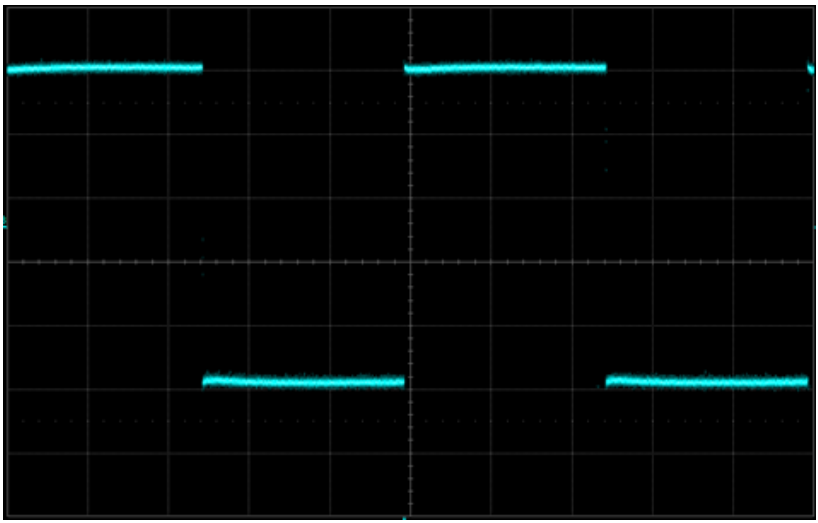
This additional tab contains specific information on the connected probe. Default values for the probes coupling and attenuation are automatically downloaded from the probe, and these settings along with other attributes are shown on the dialog.

The probe dialog showing the connected probe's control attributes.

Passive Probe Compensation

Passive probes must be compensated to flatten overshoot. This is accomplished by means of a trimmer at the connector end of the probe.

1. Attach the connector end of your passive probe to any channel.
2. Connect the probe end to the CAL output connector at the front of the oscilloscope. Ground the probe.
3. Adjust the trim pot at the connector end of the probe until the square wave is as flat as possible.



Front Panel

The following Basic Control topics cover the general usage of the **hardware** buttons located on the oscilloscope's front panel and the screen control interface elements of the **software**.

NOTE: Many specific Front Panel Controls directly correspond with Screen Layout Controls. For example, the Print front panel button corresponds with the Hardcopy function at Utilities → Utilities Setup → Hardcopy.

The front panel is divided into sections based on various functions. The following topics explain these sections in more detail.

Miscellaneous Controls and WaveStream Indicator

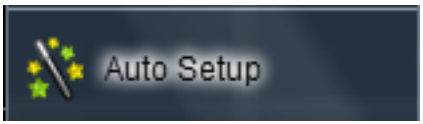
- **Help** - Press to open the Teledyne LeCroy Online Assistant where you can click to open the oscilloscope online help table of contents, index, or search for a topic using a keyword. If the second monitor is installed, the online help opens on the second monitor.

- **Default Setup** - Press to reset the oscilloscope's settings to the default configuration. Corresponds with screen menu selection: **File → Recall Setup → Recall Default Setup...**. For a list of default settings, see **Save/Recall → Saving and Recalling Setups** (on page 202).

- **Auto Setup** - Press once and the **Auto Setup...** flyout menu opens.

OR

From the menu bar, touch the **Auto Setup...** selection from the **Vertical**, **Timebase**, or **Trigger** menus.



Press the **Auto Setup...** button on the flyout menu to perform a full auto setup. Press a **Channel Find Scale** button on the flyout menu to perform a quick auto setup for that channel only.

Press the **AUTO SETUP...** front panel button twice to perform the last selection from the **Auto Setup...** flyout menu (the default is to perform a full auto setup).

If Auto Setup is run when no channels are turned on, all channels are affected. When more than one channel is turned on, the first channel with a signal applied to it is automatically set up for edge triggering.

Perform an autosetup of all these functions together by pressing the **Auto Setup...** front panel button.

- **WaveStream** - Indicates when WaveStream mode is ON.
- **Intensity** - Press to toggle between WaveStream OFF and ON for Analog Persistence and WaveStream ON for Color Persistence. When you turn the knob, if WaveStream is ON, the WaveStream display intensity changes. When you turn the knob, if WaveStream is OFF, changes the Intensity setting. Corresponds with the screen menu selection: **Display → Display Setup** (on page 146).

Trigger Controls

- **Level** - Pressing this button sets the trigger level to 50%. Turn the knob to change the trigger threshold level. The threshold level is indicated on the Trigger label.
- **READY and TRIG'D Indicators** - The READY indicator is lit when the trigger is armed. TRIG'D is lit momentarily when a trigger occurs. A fast trigger rate causes the light to stay lit continuously.
- **Setup** - Press once to open the **Trigger Setup...** dialog. Corresponds with screen menu selection: **Trigger → Trigger Setup...**. Press the Trigger SETUP front panel button again to close the **Trigger Setup...** dialog.

- **Auto** - Press to turn on **Auto Trigger** mode, which triggers the oscilloscope after a time-out, even if the trigger conditions are not met.
- **Normal** - Press to turn on **Normal Trigger** mode, which triggers the oscilloscope each time a signal is present that meets the conditions set for the type of trigger selected.
- **Single** - Press to turn on **Single Trigger** mode, which arms the oscilloscope to trigger once (single-shot acquisition) when the input signal meets the trigger conditions set for the type of trigger selected. If the scope is already armed, it will force a trigger.
- **Stop** - Press to prevent the scope from triggering on a signal. If you boot up the instrument with the trigger in **Stop** mode, a **no trace available** message is shown. Press the Trigger AUTO front panel button to display your trace.

Horizontal Controls

NOTE: Horizontal front panel controls correspond with screen menu selection: Timebase → Horizontal Setup....

- **Delay** - Press to toggle between a zero horizontal delay value and the previous horizontal delay value. Turn to change the horizontal delay value.
- **Time/Div** - Turn to set the time/division of the oscilloscope timebase (acquisition system).

Vertical Controls

NOTE: You can turn channels on and off using the software as explained in Vertical Overview (on page 111), from The Front of Your 9xxSZi-A Slave Acquisition Module (on page 22) or from the The Front of Your 9xxMZi-A Master Acquisition Module (on page 16), where applicable.

- **Channels** - The channel buttons control both channel ON/OFF and which channel is active for the Vertical Offset and Volts/Div knobs controls. If a channel is OFF, pressing that channel button turns it on and makes it active. If a channel button is ON, pressing that channel button makes it active, and then pressing it a second time turns it OFF.
- **Offset** - Press to toggle between a zero vertical offset value and the previous vertical offset value for the selected channel. Turn to change the vertical offset value for the selected channel.
- **Gain** - Press to toggle between fixed and variable gain adjustment. Turn to change the gain value.

Zoom and Math Controls

NOTE: Zoom and Math front panel controls correspond with screen menu selection: Math → Zoom Setup....

- **Horizontal Position** - Press to reset the horizontal zoom position to zero. Turn to change the horizontal position of the selected math or zoom trace.
- **Horizontal Ratio** - Press to toggle between fixed and variable horizontal zoom ratio adjustment. Turn to change the horizontal zoom ratio of the selected math trace.
- **Quick Zoom** - Press to automatically display magnified views of up to four signal inputs on multiple grids. With four input signals, the signals are displayed along with four zoom traces, each on its own grid. Pressing this button also turns off all other traces.
- **Vertical Position** - Press to reset the vertical zoom position to zero. Turn to change the vertical position of the selected math or zoom trace.
- **Vertical Ratio** - Press to toggle between fixed and variable vertical zoom ratio adjustment. Turn to change the vertical zoom ratio of the selected math trace.

Display Dashboard

This section covers the various aspects of the user interface shown in the display of your instrument.

Screen Layout, Groupings, and Controls

The instrument's screen is divided into the following main sections:

- **Menu Bar**
- **Signal Display Grid**
- **Descriptor Labels**
- **Dialog(s)**
- **The Message Bar**

NOTE: Many front panel controls directly correspond with screen layout controls. For example, the Print front panel general control button corresponds with the Hardcopy function set from Utilities → Utilities Setup → Hardcopy.

Menu Bar

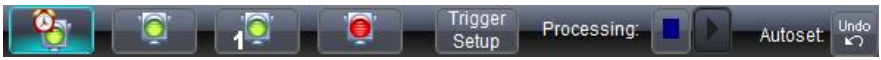
The top of the screen contains a menu bar of commonly used functions. Whenever you touch one of these buttons and make a selection from its drop-down menu, the dialog area at the bottom of the screen displays the corresponding dialog.

Specific Menu Bar functions are referenced using arrow-separated path descriptions. For example, the **Save Setup** function is referenced as **File → Save Setup...**.

NOTE: For common oscilloscope operations, you don't need to use the top menu bar (since you can access most dialogs from the Front Panel or from the Descriptor Labels). However, it is the only way to access setup or other dialogs for Display Setup, Save or Recall Waveform, Save or Recall Setups, Print Setup, Vertical (Channel), Horizontal, or Trigger Status, Memory (Reference Waveform) Setup, Pass/Fail Setup, or Utilities and Preferences Setup....

Quick Access Toolbar

The Quick Access toolbar is located on the right side of the menu bar. You can use these toolbar buttons to quickly access **Trigger**, **Processing** and **Undo** functionality.



Quick Access Trigger Functions

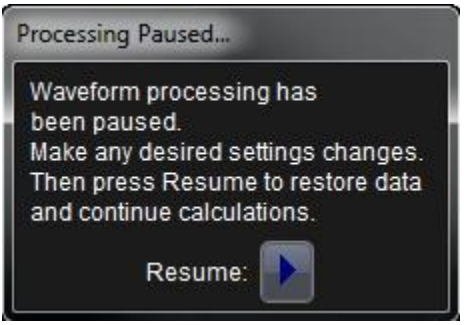
- **Auto** - Press to turn on **Auto Trigger** mode, which triggers the oscilloscope after a time-out, even if the trigger conditions are not met.
- **Normal** - Press to turn on **Normal Trigger** mode, which triggers the oscilloscope each time a signal is present that meets the conditions set for the type of trigger selected.
- **Single** - Press to turn on **Single Trigger** mode for the selected channel, which arms the oscilloscope to trigger once (single-shot acquisition) when the input signal meets the trigger conditions set for the type of trigger selected. If the oscilloscope is already armed, it forces a trigger.

- **Stop** - Press to prevent the oscilloscope from triggering on a signal. If you boot up the instrument with the trigger in **Stop** mode, the message "no trace available" is shown.
- **Trigger Setup** - Press to open the **Trigger Setup...** dialog. Corresponds with screen menu selection: **Trigger → Trigger Setup...**.

Quick Access Processing Functions

The **Processing** section allows you to suspend your system from processing data. You can stop data processing, make adjustments, and then resume data processing with the touch of two on-screen buttons.

Touching the **Stop** button shows the **Processing Paused...** pop-up.


Processing Paused...
Waveform processing has been paused.
Make any desired settings changes. Then press Resume to restore data and continue calculations.
Resume:

Touch the **Resume** button to continue processing data.

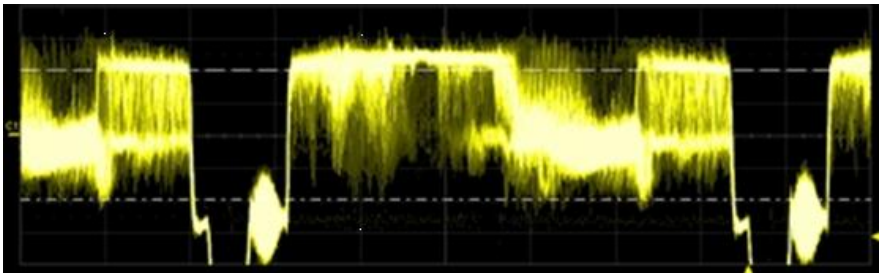
At times, an **Undo** button is made available to the right of the Quick Access Toolbar on the Menu Bar.

Quick Access Undo Function

The **Undo** button is labeled with the most recent action (Autoset being the most recent action in the screen-shot of the Quick Access Toolbar at the beginning of this topic). This helps make you aware of the specific function prior to reversal.

Signal Display Grid

The grid area is divided into 8 vertical divisions and 10 horizontal divisions just like any other oscilloscope. Set up the signal display area by touching **Display → Display Setup...** from the menu bar. The **Display** dialog offers a choice of grid combinations and can also set the grid intensity.



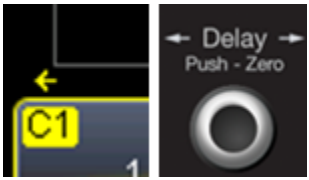
There are several indicators on the grid to help you understand the following:

- **Trigger Delay** - This indicator is located along the bottom edge of the grid. Trigger delay allows you to see the signal prior to the trigger time.

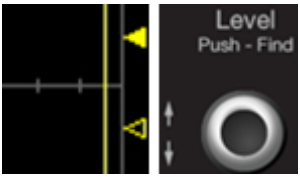
All trigger delay values (including post-trigger delay, shown here) are displayed in the Timebase Descriptor Label. Zero delay is the horizontal center of the oscilloscope display.

The default setting (Time) is for delay readout (in seconds) and to move proportionately when the timebase knob is turned. If you want to set delay (Div) to a fixed position on the grid, and then have it stay fixed as the timebase changes, go to **Utilities → Preference Setup...** and select the **Acquisition** dialog to make the setting.

- **Post-trigger Delay** - This is indicated by a left-pointing arrow to the lower-left of the grid. Pre-trigger delay is indicated by a right-pointing arrow to the lower-right of the grid.

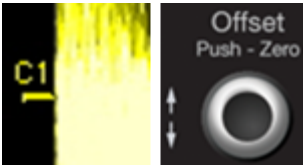


- **Trigger Level** - This indicator is located at the right edge of the grid. It tracks the trigger level as you reposition the trace up or down, or change scale. When triggering is stopped, a hollow arrow indicates where the new level ends up when triggering resumes.



Push the LEVEL knob to reset the level to 50%.

- **Zero Volts Level** - This indicator is located at the left edge of the grid. Change the zero volts level by turning the vertical **OFFSET** knob. Push the knob to reset the indicator to the middle of the grid.



Signal Display Grid Pop-Up Menu

On the Signal Display Grid, the Pop-up menu provides assistance while using the oscilloscope.

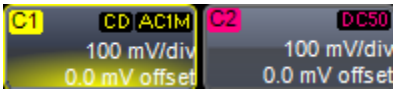
Clicking on a waveform opens a pop-up menu. From this pop-up menu, you can perform the following functions:

- Open the Setup dialog for the trace
- Turn the trace descriptor label off
- Open the Math dialog for the trace
- Open the Measure dialog for the trace
- Annotate the selected trace

Trace Descriptor Labels

Shown just beneath the grid display, these boxes provide a summary of your channel, timebase, and trigger settings.

When a trace is selected its corresponding descriptor label is shown highlighted.



The C1 Trace Descriptor Label is selected; C2 is not.

Make vertical or horizontal channel adjustments by touching the respective label. The setup dialog for the function is shown beneath.

Channel trace labels show the vertical settings for the trace and cursor information (if cursors are in use). The title bar of the label includes indicators for (SinX)/X interpolation, waveform inversion (INV), deskew (DSQ), coupling (DC/GND), bandwidth limiting (BWL), and averaging (AVG).

These indicators have a long and short form, respectively.

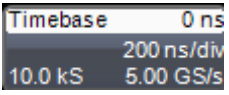
AVG	A
SINX	S
INV	I
DSQ	DQ
DC	D
Gnd	G
BwL	B

The long and short forms of trace descriptor indicators.

Besides channel traces, math and parameter measurement labels are also displayed. Labels are displayed only for traces that are turned on.

Vertical and horizontal trace descriptor (labels) are displayed below the grid. They provide a summary of your channel, timebase, and trigger settings. Make vertical or horizontal channel adjustments by touching the respective label. The setup dialog for the function is shown beneath.

TimeBase trace descriptor labels show the **trigger delay setting**, **time per division**, and **sampling information.**



Trigger trace descriptor labels show the trigger mode (Auto, Normal, or Stopped). It also shows the coupling (DC), trigger type (Edge), source (C1), level (0 mV), and slope (Positive).

Setup information for horizontal cursors, including the time between cursors and the frequency, is shown beneath the TimeBase and Trigger trace descriptor labels.

Shortcut Buttons

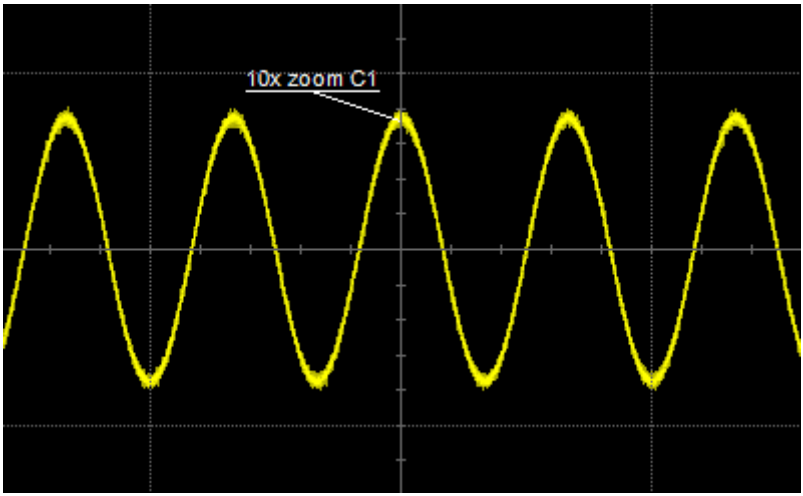
You can access the same functions as the ones produced when using the Signal Display Grid Pop-Up menu just by clicking a trace-descriptor label, which shows its corresponding dialog. From there, use the shortcut buttons at the bottom of the dialog to:

- Open the Setup dialog for the trace.
- Open the Math dialog for the trace.
- Open the Measure dialog for the trace.
- Annotate the selected trace.

For more information, see the Shortcut Buttons section of **Dialog Area** (on page 87).

Annotating Traces

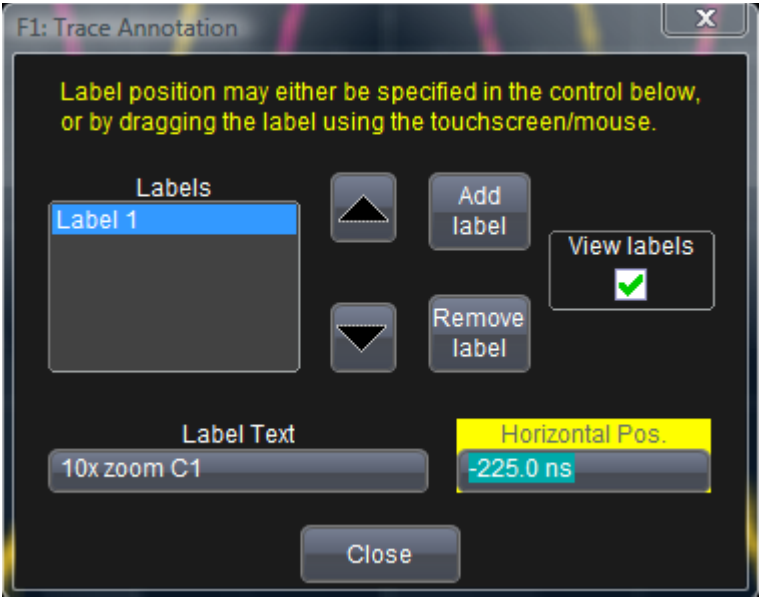
The instrument gives you the ability to add an identifying label, bearing your own text, to a waveform display:



For each waveform, you can create multiple labels and turn them all on or all off. Also, you can position them on the waveform by dragging or by specifying an exact horizontal position.

Touch the waveform you want to annotate right on the display grid, and then touch **Set label...** on the pop-up menu.

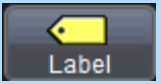
A dialog box opens in which to create the label. The first time creating a waveform label, **Label1** is provided as default text when the **Add label** button is touched.



From this pop-up you can **edit** existing annotations, change the label **placement** on the waveform, **add** labels, **remove** labels, and **toggle the visibility**. The following bullets show you how.

- If you are modifying an existing label, under **Labels** touch the label you want to change.

  NOTE: If the dialog for the trace you want to annotate is currently displayed, you can touch the label button at the bottom to display the Trace Annotation setup dialog.

  You may place a label anywhere you want on the waveform. Labels are numbered sequentially according to the order in which they are added, and not according to their placement on the waveform.

- If you want to change the label's text, touch inside the **Label Text** field. A pop-up keyboard appears for you to enter your text. Touch

O.K. on the keyboard when you are done. The edited text automatically appears in the label on the waveform.

- Precisely place the label by touching inside the **Horizontal Pos.** field and provide a horizontal value, using the pop-up numeric keypad.
- Add another label by touching the **Add label** button. Delete a label by selecting the label from the list, and then touching the **Remove label** button.
- Make labels visible by touching the **View labels** checkbox.

Dialog Area

The lower portion of your oscilloscope screen is where information is shown, selections are made, and data is input. These screens are organized into tabular displays, subtabs, or pop-up dialogs. The dialog area is controlled by **Touch Screen Controls** and **Front Panel Controls**.

Touch Screen Controls

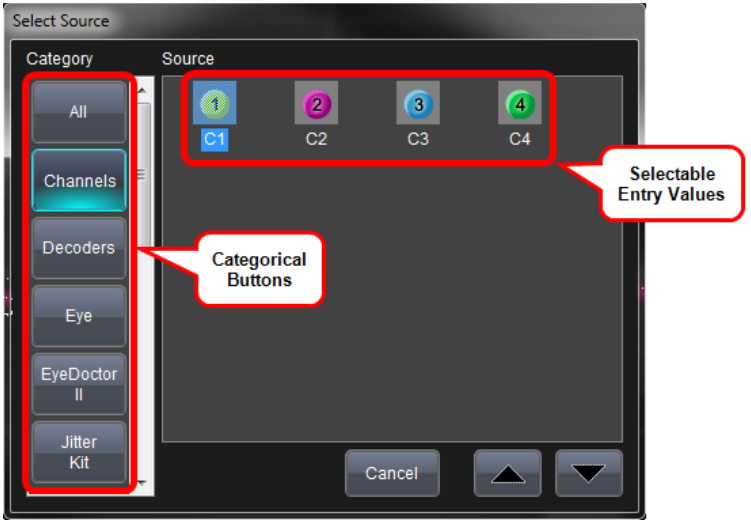
Various touch screen user interface controls are provided for easily entering data. Their functionality is described in this topic and you'll see them referenced throughout the documentation.

POP-UP SELECTOR CONTROLS

When Pop-Up selector controls are touched, sometimes a very small box is shown right inside the control - as in the following control for **Coupling** on the C1 dialog.

Pop-Up Selector Control for smaller values.

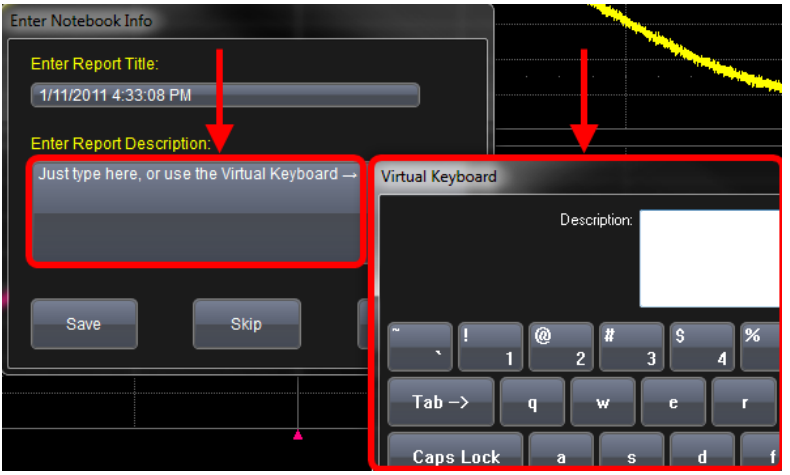
Other times, a larger box is shown after touching a control. This larger Pop-Up has categorical buttons along the left column along with labels (and sometimes descriptions) for the selectable entry values.



Pop-Up Selector Control for values with varied types.

TEXT ENTRY CONTROLS

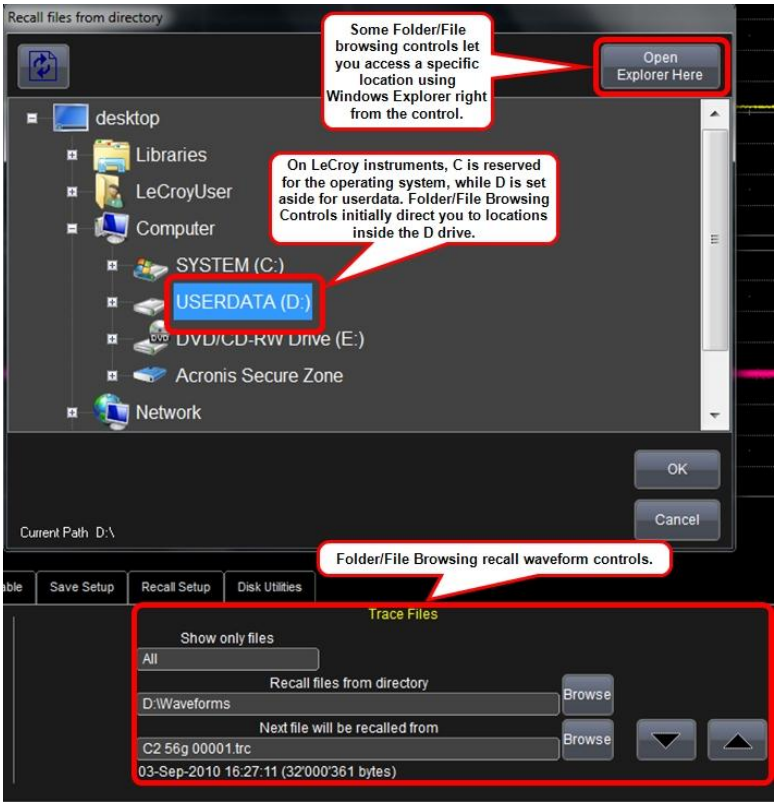
Most controls can be touched once and you can then provide a value using an attached (or double-touch/click to use the Virtual, on-screen) keyboard.



Text entry field for LabNotebook using the Virtual Keyboard.

FOLDER/FILE BROWSING CONTROLS

These controls allow for navigation to or from folders (on the hard drive or memory device) for retrieving or storing items such as waveforms, LabNotebook entries, to name a few.



Folder/File Browsing recall waveform controls.

NOTE: The instrument's hard disk is partitioned into drive C and drive D. Drive C contains the Windows operating system and the instrument application software. Drive D is intended for data files.

FLYOUT MENU CONTROLS

Flyout Menus provides a variety of solutions for a particular main area of functionality. It does this by providing a set of buttons subdividing the control into more specific functions on the right-side of the display.

An example of Flyout Menu Controls is seen in the **Setup** front panel button.

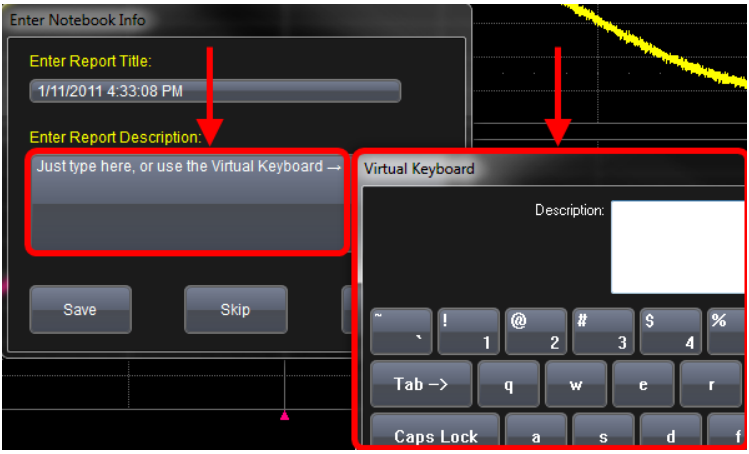
Setup Flyout Menu control.

PRECISION DATA ENTRY CONTROLS

Certain fields requiring precise value entry assist you by having precision entry means. When these controls are selected, you can provide values as follows:

Keyboard

Touch inside a text entry control and you can manually type the value in using an attached (or double-touch/click to use the Virtual, on-screen) keyboard.



Text entry field for LabNotebook using the Virtual Keyboard.

Slider Bar

Some models provide what is known as a **Slider Bar** along the bottom of the screen **when a keyboard is attached** to the instrument. The Slider Bar allows you to select your entered value by moving a horizontal slider (left to right provides low to high amounts).

Pop-Up Keypad

Some models provide a pop-up Keypad when you touch twice in the same control. A keypad button is also provided on the slider bar (on models that have the slider bar) which shows the pop-up keypad when touched.

For many controls, once the Pop-Up Keypad is shown the **Front Panel Controls** can be used to adjust the value in the pop-up. The Pop-Up contains **Up** and **Down** arrow buttons, **Set to Max**, **Default**, and **Min** buttons, and the **Keypad** itself for providing your value.

The slider bar also has a handy default value button for quickly entering the default for the control. This button only appears if a keyboard is attached.

Shortcut Buttons

Several dialogs contain common functions accessible from a row of buttons that can save you a step or two when using a particular function (instead of accessing the respective location from the menu bar or the Signal Display Grid Pop-Up Menu).

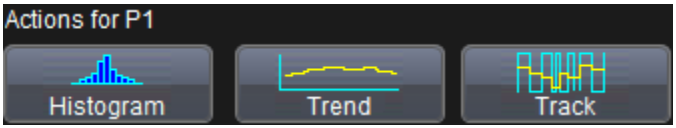
For example, at the bottom of the Channel Setup dialog, these buttons perform the following functions:

- **Measure** - Opens the Measure menu. You can then select a parameter from this menu without leaving the Channel Setup dialog. The parameter automatically appears below the grid.
- **Zoom** - Creates a zoom trace of the channel trace whose dialog is currently displayed.
- **Math** - Opens the Math menu. You can then select a math function from this menu without leaving the Channel Setup dialog. A math trace of the channel whose dialog is currently open is automatically displayed.
- **Decode** - Opens the main Serial Decode dialog where protocol option measurements can be applied to signals.
- **Store** - Loads the channel trace into the next available memory location (M1 to M4).
- **Find Scale** - Automatically performs a vertical scaling that fits the waveform into the grid.
- **Next Grid** - Automatically moves the channel trace whose dialog is currently open onto the next grid. If you have only one grid displayed, a new grid will be created automatically, and the trace moved.

  NOTE: This button is not available on all oscilloscope models.

- **Label** - Enables you to attach identifying labels to your waveforms. The labels are preserved when the waveform is saved as a LabNotebook entry and when saved to file.
- **Probe Cal - Cable Deskew** - Opens the Probes Cal. dialog where various Gain, Offset, Skew, Source, and Advanced controls are available for probe signal calibration.

Another example is seen in the buttons appearing at the bottom of the Measure **Px** dialogs. The button may be selected in order to display the functions (sometimes called Actions) named on the buttons:



Actions for Trace buttons on the Cx dialog.

Using these buttons allow you to remain in the Measure dialog while setting up a Math trace on a parameter measurement.

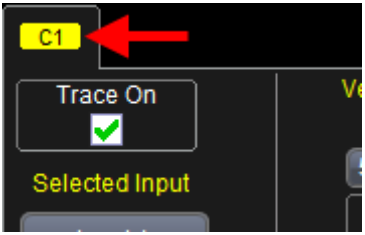
Message Bar

At the bottom of the oscilloscope display is a narrow message bar. The current date and time are displayed at the far right. Status, error, or other messages are also shown in this area.

Turning on Channels and Traces

Turn on a channel, math, or memory trace using the Front Panel channel buttons, or the menu bar**.**

The dialog at the bottom of the screen automatically switches to the vertical setup or math setup dialog for that selection.The tab on this dialog is labeled with the corresponding channel number:



You can configure your traces from here, including math setups.

PLEASE NOTE THE FOLLOWING:

- If you want to display each trace on its own grid automatically, enable Autogrid by touching Display → Autogrid from the menu bar.
- You can turn channels on and off using the software, for more information see Vertical Overview (on page 111)
- On the front panel, press a channel select button to display the trace descriptor label for that input channel and turn on the channel.

> **NOTE:** On a LabMaster 9 Zi-A, you can also turn channels on and off from the front of the 9xxSZi-A Slave Acquisition Module or from the front of the 9xxMZi-A Master Acquisition Module, where applicable.

- Turn on a math function trace by touching Math → Math Setup... from the menu bar. Touch the corresponding On checkbox to activate the desired trace.
- You can also quickly create traces (and turn on the trace label) for math functions and memory traces, without leaving the Vertical Adjust dialog, by touching the icons at the bottom of the Vertical Adjust dialog.

Timebase

Timebase Overview

You can access Timebase settings using the front panel **Horizontal** controls, the **Timebase → Horizontal Setup...** on the menu bar, or by touching the Timebase trace descriptor label. The main **Timebase** dialog is then shown and contains sections for **Sampling Mode**, **Timebase Mode**, and **Real Time Memory**.

A section specifically used for combining channels is located on the **far right of the main Timebase dialog**. This section varies based on your oscilloscope model.

Combining Channels

Digital Bandwidth Interleave (DBI) is a method for combining channels to double or triple bandwidth, sample rate, and memory lengths - just as oscilloscope manufacturers have for years interleaved channels to increase sample rate and memory.

Access the DBI dialog from the TimeBase dialog at **TimeBase → Horizontal Setup...** (touch the DBI tab to show the dialog). You can combine channels for the Master Acquisition Module (where applicable) and each Slave Acquisition Module.

A pop-up is shown when using the DBI button controls verifying the proper connector saver (2.92 mm for 30 or 36 GHZ, or 2.4 mm for 45 GHz).

Mark **Don't Show Me This Message Again** to avoid subsequent warnings.

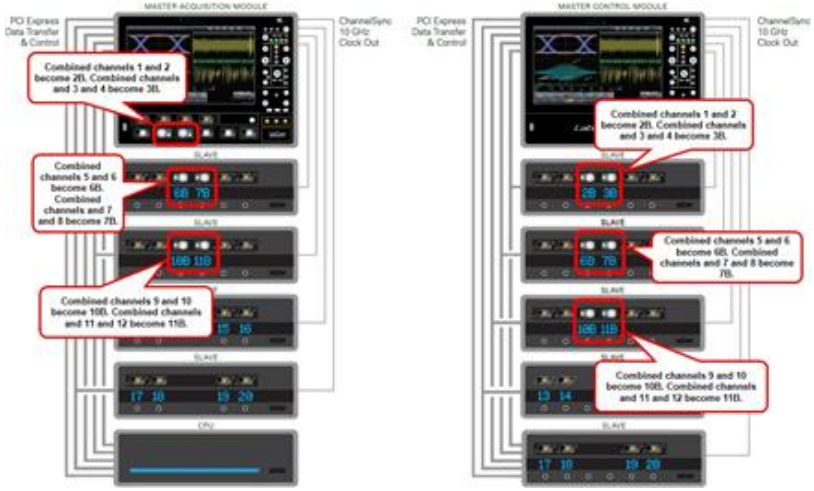
C3 Input B adapter message
Teledyne LeCroy supplies 2.92 mm connector savers for use at this bandwidth. These connector savers guarantee mode-free operation up to 40 GHz. Please make sure one of them is attached now.
OK
Don't Show Me This Message Again

The 2.92 mm connector saver pop-up.

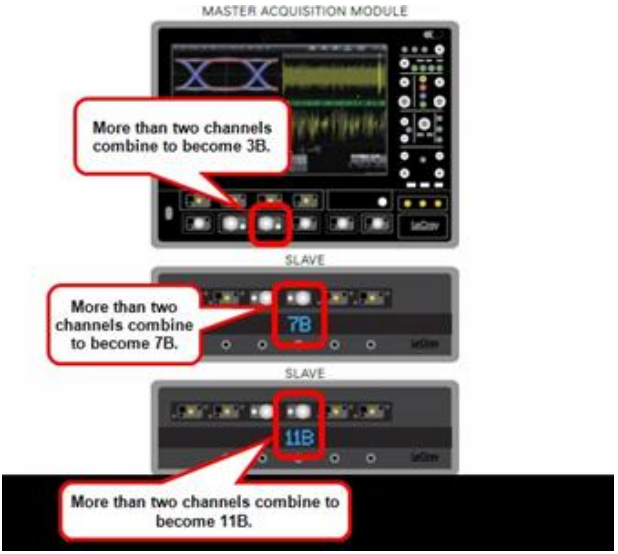
C3 Input B adapter message
Teledyne LeCroy supplies 2.4 mm connector saver for use at this bandwidth. These operate mode-free beyond the 45 GHz channel bandwidth rating. The internal pin of a 2.4 mm connector has a smaller diameter than the 2.92 connector. Please make sure one of them is attached now.
OK
Don't Show Me This Message Again

The 2.4 mm connector saver pop-up.

When selected, the respective channels are combined into one channel at higher bandwidth. The combined channel pairs for 30 or 36 GHz models look like the following (depending on your specific setup):


MASTER ACQUISITION MODULE
PCI Express Data Transfer & Control
ChannelSync 10 GHz Clock Out
Combined channels 1 and 2 become 2B. Combined channels and 3 and 4 become 3B.
Combined channels 5 and 6 become 6B. Combined channels and 7 and 8 become 7B.
Combined channels 9 and 10 become 10B. Combined channels and 11 and 12 become 11B.
SLAVE
CPU
MASTER CONTROL MODULE
PCI Express Data Transfer & Control
ChannelSync 10 GHz Clock Out
Combined channels 1 and 2 become 2B. Combined channels and 3 and 4 become 3B.
Combined channels 5 and 6 become 6B. Combined channels and 7 and 8 become 7B.
Combined channels 9 and 10 become 10B. Combined channels and 11 and 12 become 11B.
SLAVE

The channel pairs for a 45 GHz setup looks like the following:



When DBI is selected, trace descriptor labels correspond with your choices. So, a 30 or 36 GHz example where you decided to interleave both **C1/C2** and **C3/C4** pairs, trace descriptor labels are shown as follows:

- **C1** - Shown as inactive
- **C2** - Shown as active
- **C3** - Shown as active
- **C4** - Shown as inactive

Master Acquisition Module DBI Settings

When you use DBI and make correct connections and channel selections from the **TimeBase → Horizontal Setup...** dialog, the system makes value changes for you.

- View these changes by touching the **trace descriptor label** for an interleaved channel.
- The **Vertical Scale B Scale V/div** (Timebase) value is automatically set to **50 mV/div**. If you set this to a different value and deactivate DBI, the system retains the last one used when DBI is reactivated.
- The channel LEDs form the following configuration in **30** or **36 GHz mode** on a **Master Acquisition Module**:

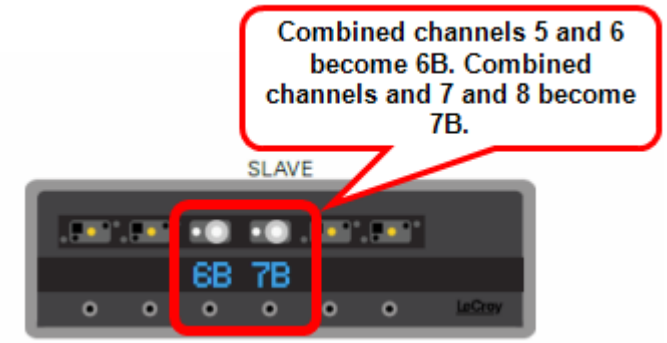
Channel 1	Channel 2	Channel 3	Channel 4
OFF, No LED Light ▲	Green Down Arrow ▼	Green Down Arrow ▼	OFF, No LED Light ▲

- The channel LEDs form the following configuration in **45 GHz mode** on a **Master Acquisition Module**:

Channel 1	Channel 2	Channel 3	Channel 4
OFF, No LED Light ▲	OFF, No LED Light ▲	Green Down Arrow ▼	OFF, No LED Light ▲

SLAVE ACQUISITION MODULE DBI SETTINGS

When you use DBI and make correct connections and channel selections from the **TimeBase → Horizontal Setup...** dialog, the system makes value changes for you on your **Slave Acquisition Module**. The blue, numeric channel LEDs form the following configuration in **45 GHz mode** on a **Slave Acquisition Module**:



PLEASE NOTE THE FOLLOWING:

- When using DBI, use Channel 3 for 30 or 36 GHz mode high-speed serial triggering.
- When using DBI, use Channel 4 for 45 GHz mode high-speed serial triggering.

Timebase Setup and Control

1. With the Timebase dialog showing, touch inside the **Time/Division** data entry control and provide a value using your preferred input control method. Additional information on using the touch screen controls can be found in the **Dialog Area** (on page 87).
2. Touch inside the **Delay** data entry control and provide a value.

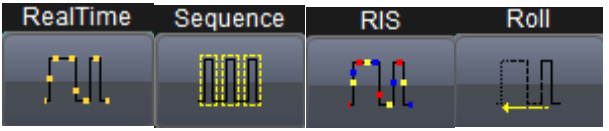
Sampling Modes

Sampling Modes Overview

Depending on your timebase, you can choose **Single-shot Sampling Mode** (below), also known as Real Time mode, **Sequence Sampling Mode** (on page 101), or **RIS Sampling Mode** (on page 108) mode sampling.

Newer instruments offer **Roll Mode** (on page 110)

Some instruments also offer **Roll Mode** (on page 110).



Selecting a Sampling Mode

1. Touch **Timebase → Horizontal Setup...** from the menu bar.
2. In the **Timebase** dialog, touch a **Sample Mode** button.
3. If you chose **Sequence Mode**, touch the **Sequence** tab. The **Sequence** dialog is shown. Use the following controls to provide details for controls such as **Number of Segments**, **Enable Timeout**, **Timeout** (value), **Display Mode**, and **Show Sequence Trigger Times**.

Single-shot Sampling Mode

Basic Capture Technique

A single-shot acquisition is a series of digitized voltage values sampled on the input signal at a uniform rate. It is also a series of measured data values associated with a single trigger event. The acquisition is typically stopped a defined number of samples after this event occurs: a number determined by the selected trigger delay and measured by the timebase. The waveform's horizontal position (and waveform display in general) is determined using the trigger event as the definition of time zero.

You can choose either a pre- or post-trigger delay. Pre-trigger delay is the time from the left-hand edge of the display grid forward to the trigger event, while post-trigger delay is the time back to the event.

You can sample the waveform in a range starting well before the trigger event up to the moment the event occurs. This is 100% pre-trigger, and it allows you to see the waveform leading up to the point at which the trigger condition was met and the trigger occurred. (The instrument offers up to the maximum record length of points of pre-trigger information.) Post-trigger delay, on the other hand, allows you to sample the waveform starting at the equivalent of 10,000 divisions after the event occurred.

On fast timebase settings, the maximum single-shot sampling rate is used. But for slower timebases, the sampling rate is decreased and the number of data samples maintained.

The relationship between sample rate, memory, and time can be simply defined as:

$$Capture\ Interval = 1/Sample\ Rate\ X\ Memory$$

and

$$Capture\ Interval/10 = Time\ Per\ Division$$

Sequence Sampling Mode – Working with Segments

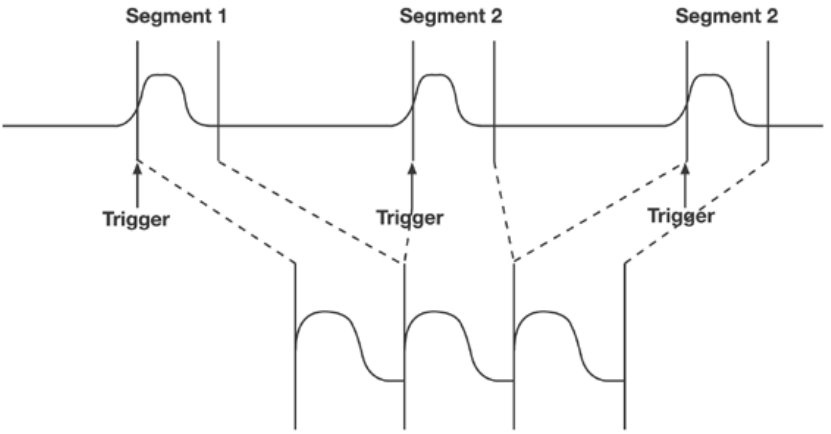
Using Sequence Mode, thousands of trigger events can be stored as segments into the oscilloscope's memory (the exact number depends on oscilloscope model and memory options). This is ideal when capturing many fast pulses in quick succession or when capturing few events separated by long time periods. The instrument can capture complicated sequences of events over large time intervals in fine detail, while ignoring the uninteresting periods between the events. You can also make time measurements between events on selected segments using the full precision of the acquisition timebase.

Sequence mode offers a number of unique capabilities:

- You can acquire up to four channels simultaneously.
- You can minimize dead time between trigger events for consecutive segments.
- You can view time stamps for acquisitions.
- You can zoom segments or used them as input to math functions.

- You can combine sequence mode with an advanced trigger to isolate a rare event, capture all instances over hours or days, and view/analyze each afterwards.
- You can use Sequence mode in remote operation to take full advantage of the instrument's high data-transfer capability.

In Sequence mode, the complete waveform consists of a number of fixed-size segments acquired in single-shot mode (see the instrument specifications for the limits). The oscilloscope uses the sequence timebase setting to determine the capture duration of each segment as 10 x time/div. With this setting, the oscilloscope uses the desired number of segments, maximum segment length, and total available memory to determine the actual number of samples or segments, and time or points.

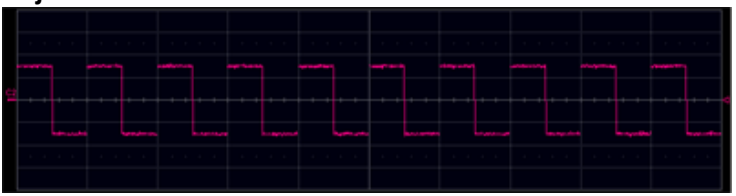


How the instrument captures segments

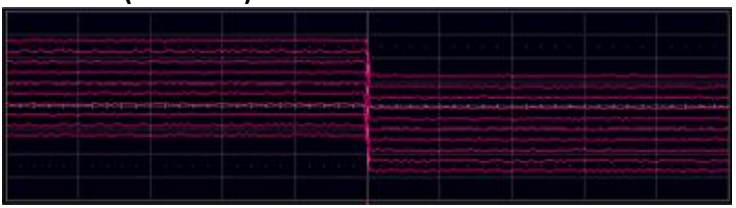
Sequence Display Modes

The instrument gives you a choice of five ways to display your segments:

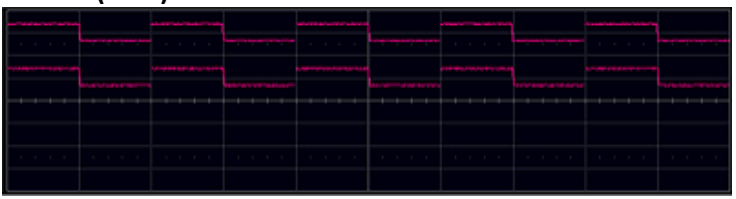
- **Adjacent**



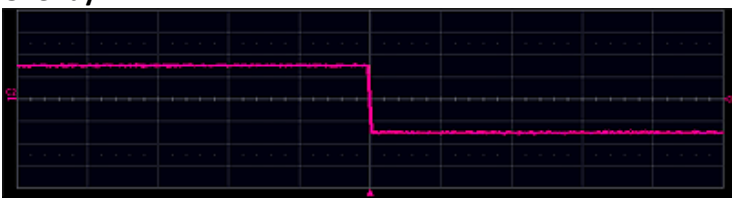
- **Waterfall (cascaded)**



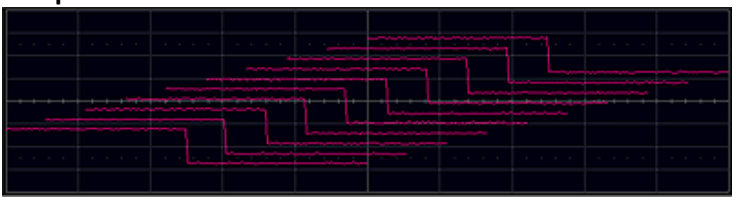
- **Mosaic (tiled)**



- **Overlay**



- **Perspective**



NOTE: some display modes have limitations on the number of segments that can be shown at one time.

Sequence Mode Setup

When setting up Sequence Mode, you define the number of fixed-size segments acquired in single-shot mode (see the instrument specifications for the limits). The oscilloscope uses the sequence timebase setting to determine the capture duration of each segment. Along with this setting, the oscilloscope uses the number of segments, maximum segment length, and total available memory to determine the actual number of samples or segments, and time or points.

Setting up Sequence Mode (Adjacent)

1. Touch **Timebase → Horizontal Setup...** on the menu bar.
2. Click the **Sequence** tab.
3. Under **Acquisition Settings**, touch inside the **Num Segments** data entry control and provide a value using your preferred input control method. Additional information on using the touch screen controls can be found in the **Dialog Area** (on page 87).

> **NOTE:** The number of segments you choose to display can be less than the total number of segments in the waveform. For example, in the pop-up images above, the number of display segments is 10, but the total number of segments entered in the timebase dialog's Num Segments control is 100.

4. Touch the **Enable Timeout** checkbox.
5. Touch inside the **Timeout** data entry control and provide a timeout value.

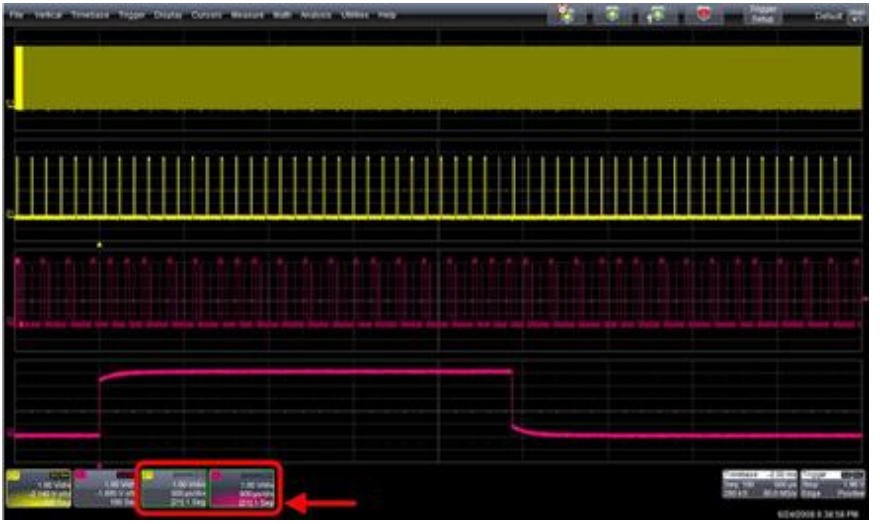
> **NOTE:** Use the sequence mode timeout to automatically interrupt the sequence acquisition if the timeout value is exceeded without a valid trigger. The timeout period accounts for instances when a Num Segments miscount occurs for some reason and the oscilloscope waits indefinitely for an unforthcoming segment. During that time, no oscilloscope functions are accessible. By means of a timeout value, however, the acquisition will be completed, the waveform displayed, and control of the oscilloscope returned to the user after the timeout has elapsed.

5. Under **Display Settings**, touch inside the **Display mode** control, and select a sequence mode display from the pop-up menu.
6. Touch the SINGLE trigger front panel button.

> **NOTE:** Once a single acquisition has started, you can interrupt the acquisition at any time by pressing the **SINGLE** front panel button a second time or by pressing the **STOP** front panel button. In this case, the segments already acquired will be retained in memory.

Zooming Segments in Sequence Mode

You can zoom individual segments easily using the **QUICKZOOM** front panel button. When you zoom, the zoom traces default to Segment 1. Channel descriptors indicate the total number of segments acquired. Zoom descriptors indicate [Seg #] and #Segments in the Zoom. You can scroll through the segments using **ZOOM** front panel position knob.



Sample Zoom of Segments in Sequence Mode

1. Touch the front panel **Quickzoom** button.

2. Turn the **ZOOM** front panel position knob to scroll through the segments.
3. To vary the degree of zoom, touch the newly created **Zx** trace label. The setup dialog for the zoom (Z1 to Z4) opens. It shows the current horizontal and vertical zoom factors.
4. If you want to increase or decrease your horizontal or vertical zoom in small increments, touch the **Var.** checkbox to enable variable

zooming. Now with each touch of the **zoom control** buttons, the degree of magnification changes by small increments.

OR

If you want to zoom in or out in large standard increments with each touch of the zoom control buttons, leave the **Var.** checkbox unchecked.

OR

If you want to set exact horizontal or vertical zoom factors, touch inside the Horizontal **Scale/div** data entry control and enter a time-per-div value, using the pop-up numeric keypad. Then touch inside the Vertical **Scale/div** control and enter a voltage value.

Displaying an Individual Segment

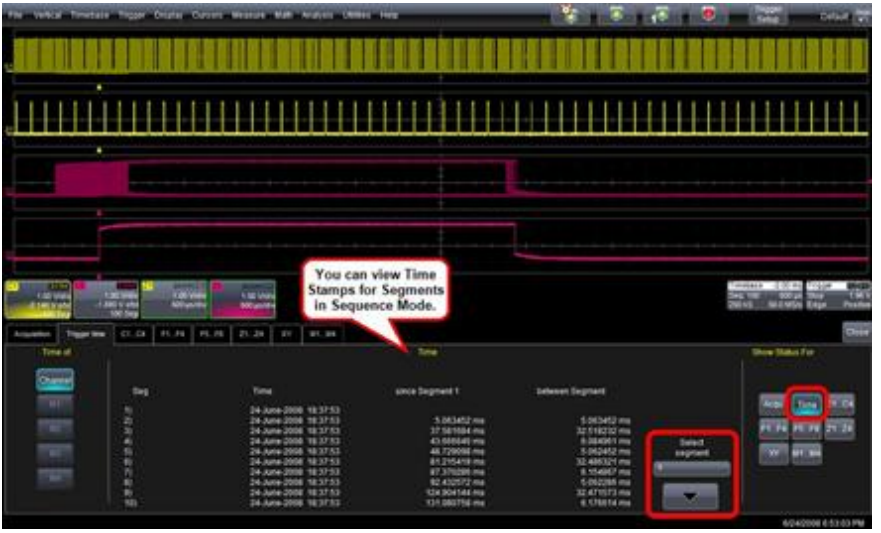
1. Touch **Math → Math Setup...** on the menu bar.
2. Touch a function tab **Fx** showing its corresponding dialog.
3. On the dialog, touch inside the **Operator1** control and select the **Segment** button from the pop-up menu.

4. In the dialog on the right, touch the **Select** tab.
5. Touch inside the **First Selected** data entry control and select the first segment you want to display. Use the same method to provide a value in the **Number of Selected** data entry control.

NOTE: In Persistence mode, the segments are automatically overlaid one on top of the other in the display. In non-Persistence mode, they appear separately on the grid.

Viewing Time Stamps

You can view time stamps for each segment.



View Segment Time Stamps

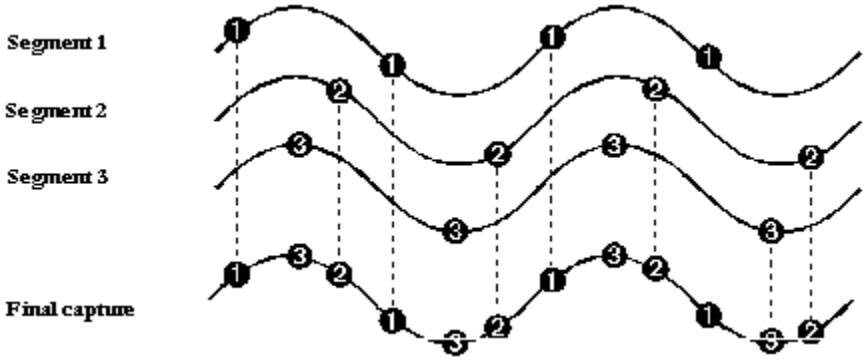
1. Touch **Timebase → Acquisition Status** on the menu bar.
   OR
   Touch **Vertical → Channel Status** on the menu bar.
2. Touch the **Trigger Time** tab.
3. Under **Show Status For**, touch the **Time** button.
4. Touch inside the **Select Segment** control and enter a segment number value (you can also touch the arrow buttons to scroll through segment times).

RIS Sampling Mode - For Higher Sampling Rates

RIS (Random Interleaved Sampling) is an acquisition technique that allows effective sampling rates higher than the maximum single-shot sampling rate. It is used on repetitive waveforms with a stable trigger. The maximum effective RIS sampling rate is achieved by making multiple single-shot acquisitions at maximum real-time sample rate. The bins thus acquired are positioned approximately 5 ps (200 GS/s) apart. The process of acquiring these bins and satisfying the time constraint is a random one. The relative

time between ADC sampling instants and the event trigger provides the necessary variation.

The instrument requires multiple triggers to complete an acquisition. The number depends on the sample rate: the higher the sample rate, the more triggers are required. It then interleaves these segments (in the following graphic) to provide a waveform covering a time interval that is a multiple of the maximum single-shot sampling rate. However, the real-time interval over which the instrument collects the waveform data is much longer, and depends on the trigger rate and the amount of interleaving required.



NOTE: RIS mode is not available when the oscilloscope is operating in fixed sample or DBI 25 - 45 GHz) modes as covered in Smart Memory (available in the online help files) and Combining Channels topics, respectively.

Roll Mode

Roll mode displays, in real time, incoming points in single-shot acquisitions that have a sufficiently low data rate. The oscilloscope rolls the incoming data continuously across the screen until a trigger event is detected and the acquisition is complete.

The parameters or math functions connected to each channel are updated every time the roll mode buffer is updated, as if new data is available. This resets statistics on every step of Roll mode that is valid because of new data.

NOTE: If the processing time is greater than the acquire time, the data in memory gets overwritten. In this case, the instrument issues a Channel data is not continuous in ROLL mode!!! warning and rolling starts over again.

Vertical

You can access Vertical settings using the front panel **Vertical** controls, by selecting **Vertical→ Channel Setup...** on the menu bar, or by touching the Channel trace descriptor label. The following screen-shot shows the **C1 Vertical** dialog on a LabMaster as an example. For each channel, a corresponding **Vertical** dialog contains sections with respective controls.

1. **Channel Controls** (below) let you set up individual channels.
2. **Actions for Trace C1 Buttons** (on page 114) let you perform certain actions on the channel, such as Math, Zoom, and Measure actions.
3. **Pre-Processing Controls** (on page 115) let you set up pre-process controls, such as cable de-embedding and interpolation.

NOTE: You can turn channels on and off using this dialog, from the front of the 9xxSZi-A Slave Acquisition Module, from the front of the 9xxMZi-A Master Acquisition Module, or from the LabMaster 9 Zi-A Channel Setup dialog.

For LabMaster, the additional **LabMaster 9 Zi-A Channel Setup** (on page 119) and **LabMaster 9 Zi-A ChannelSync™ Calibration Dialog** (on page 70) provide even more channel trace controls.

Channel Controls

The individual Channel Controls section of the dialog provides the following functions for your respective channel:

- **Channel Inputs** - For each channel, you can set the Channel Input to either Input A (Upper) or Input B (Lower). The Channel Row LED Indicators display which input is set for each channel.

  NOTE: **Slave Acquisition Modules** indicate alternative, or B channels, on named LED indicators

- **Vertical Scale** - For each channel, you can set the vertical scale or sensitivity and choose whether to use fixed or variable gain adjustment.

- **Vertical Offset** - For each channel, you can select between zero vertical offset or to set the offset to a specific value.
- **Coupling** - The maximum input voltage depends on the input used. Values are displayed on the front of the oscilloscope. Whenever the voltage exceeds this limit, the coupling mode automatically switches from DC 50 Ω to GROUND. You then have to manually reset the coupling to DC 50 Ω.

  CAUTION. While the unit does provide this protection, damage can still occur if extreme voltages are applied
- **Bandwidth** - Bandwidth filters are available at the following levels:

  Full (all X-Stream oscilloscopes), 30 GHz, 25 GHz, 20 GHz, 16 GHz, 13 GHz, 8 GHz, 6 GHz, 4 GHz , 3 GHz , 1 GHz , 200 MHz (all X-Stream oscilloscopes), and 20 MHz (all X-Stream oscilloscopes).

  WaveMaster and **LabMaster** - 45 GHz, 30 GHz, 25 GHz, 20 GHz, 16 GHz, 13 GHz, 8 GHz, 6 GHz.

  WavePro and WaveMaster - 4 GHz, 3 GHz, 1 GHz, 200 MHz, and 20 MHz.

  WaveRunner - 1 GHz, 200 MHz, and 20 MHz.

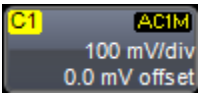
PLEASE NOTE THE FOLLOWING:

- Each oscilloscope contains only the Full selection and those bandwidths less than the rated oscilloscope bandwidth.
- Anti-aliasing filters are applied to limit bandwidth at lower sample rates, regardless of bandwidth limit selection.
- Probe - Teledyne LeCroy's ProBus, ProLink, and 2.92 mm system automatically senses probes and sets their attenuation for you. For each channel, the probe attenuation can also be set manually.

Setting Up Channels

1. Touch **Vertical → Channelx Setup...** from the menu bar.
2. Touch inside the **Trace On** checkbox to display the trace.
3. On pertinent model oscilloscopes, under **Selected Input**, touch the **Input A (Upper)** button or **Input B (Lower)** button. Otherwise, no Selected Input buttons are provided.
4. Turn the **VERTICAL GAIN** front panel knob for the selected channel.
   OR
   Touch inside the **Volts/Div** field and enter a value. Click the **keypad** button to enter a value using the pop-up keypad, or use the up/down arrows.

   The set voltage is shown on the trace descriptor label and in the Volts/Div field in the dialog.

5. Turn the **VERTICAL OFFSET** adjust front panel knob directly above the channel button whose waveform you want to move vertically. Or you can touch inside the **Offset** field and type in a value on the pop-up keypad. To set the vertical offset to zero, touch the **Zero** button directly below the **Offset** field.
6. Touch inside the **Coupling** control and select a coupling mode from the pop-up menu.
7. Touch inside the **Bandwidth** control and provide a Bandwidth Limit value using your preferred input control method. Additional information on using the touch screen controls can be found in the **Dialog Area** (on page 87).
8. Touch inside the **Probe Atten.** data entry control if you want to set the attenuation manually, and provide a value using your preferred input control method. Additional information on using the touch screen controls can be found in the **Dialog Area** (on page 87).

Shortcut Buttons

Shortcut buttons provide quick access to various functions for your respective channel. The following functions are available:

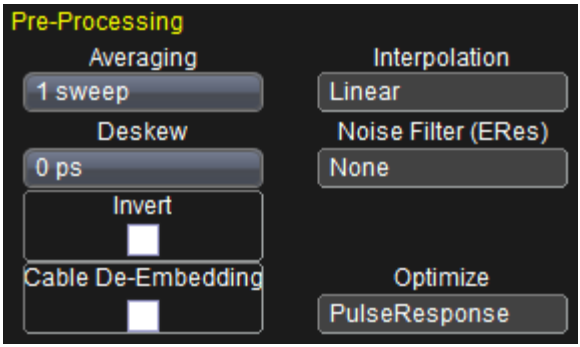
- **Measure** - Turn on a Measurement trace. Choose a measurement parameter from the Measurement pop-up window to determine a wide range of waveform properties. For example, you can use measurement parameters to automatically calculate many attributes of your waveform, like rise-time, rms voltage, and peak-to-peak voltage.
- **Zoom** - QuickZoom automatically displays a zoom of the channel or trace on a new grid.
- **Math** - Turn on a Math trace. Choose a Math function from the Math pop-up window.
- **Decode** - Shows the main Decode dialog.
- **Store** - Transfers the current trace into a corresponding memory trace.
- **Find Scale** - Automatically calculates peak-to-peak voltage, and chooses an appropriate Volts/Div scale to fully display the waveform.
- **Next Grid** - This button transfers a copy of your waveform into another grid. If another grid is not showing, the system creates a new grid for you.

  NOTE: This button is disabled while using Auto Grid.

- **Label** - Shows the Trace Annotation pop-up where you can provide label text and positioning information.

Pre-Processing Controls

Pre-Processing is meant as before Math processing. Pre-Processing controls provide the following functions for your respective channel:



- **Averaging** - Specifically performs continuous averaging or the repeated addition, with unequal weight, of successive source waveforms. It is particularly useful for reducing noise on signals drifting very slowly in time or amplitude. The most recently acquired waveform has more weight than all the previously acquired ones: the continuous average is dominated by the statistical fluctuations of the most recently acquired waveform. The weight of old waveforms in the continuous average gradually tends to zero (following an exponential rule) at a rate that decreases as the weight increases.
- **Deskew** - Adjusts the horizontal time offset by the amount entered. The valid range is dependent on the current timebase setting. Pre-processing deskew and the Math deskew function perform the same activity.
- **Invert** - Invert the waveform for the selected channel.
- **Cable De-Embedding** - When making measurements on serial data signals, losses in the cables used in the test setup can reduce the accuracy of your signal (for example, signal amplitude and risetime), as well as introduce Inter-Symbol Interference. These cable effects can dramatically alter your serial data measurements and potentially create mask test violations. The Cable De-Embedding option allows you to quickly specify the characteristics of the cables (typically

found on the cable's data sheet) in your test setup and analyze your signal with the effects of the cables removed.

NOTE: The Cable De-Embedding checkbox is only available if you have the option.

- **Interpolation** - Linear interpolation, which inserts a straight line between sample points, is best used to reconstruct straight-edged signals such as square waves. (Sinx)/x interpolation, on the other hand, is suitable for reconstructing curved or irregular wave shapes, especially when the sample rate is 3 to 5 times the system bandwidth.
- **Noise Filter** - Enhanced Resolution (ERES) filtering increases vertical resolution, allowing you to distinguish closely spaced voltage levels. The tradeoff is reduced bandwidth. The functioning of the instrument's ERES is similar to smoothing the signal with a simple, moving-average filter. Use ERES on single-shot waveforms, or where the data record is slowly repetitive (when you cannot use averaging). Use it to reduce noise when your signal is noticeably noisy, but you do not need to perform noise measurements. It also may be used when performing high-precision voltage measurements: zooming with high vertical gain, for example.

Response Optimization Modes

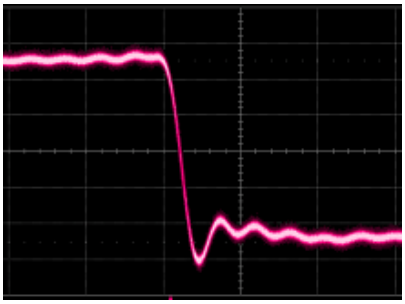
Frequency response and group delay of the oscilloscope contributes to the pulse response characteristics of the oscilloscope. By slightly adjusting these characteristics using digital signal processing, the characteristic response of the oscilloscope can be optimized for your specific application.

Frequency response is defined as the decrease in the magnitude response with respect to frequency. A fourth-order Bessel roll-off slightly attenuates the frequencies near the bandwidth rating of the oscilloscope while a brick-wall frequency response passes slightly higher frequency content.

Group delay is defined as the rate of change of the total phase shift with respect to angular frequency through a device or transmission medium. Amplifiers in analog oscilloscopes typically have some group delay at the highest frequencies. This inherent group delay minimizes the preshoot present on a step response and provides the traditional pulse response with no preshoot before the step. When zero group delay is provided at all frequencies, preshoot and overshoot is equalized.

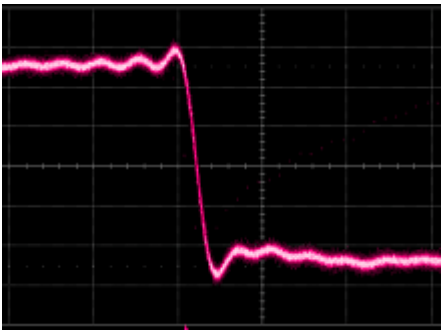
Teledyne LeCroy provides three choices for Response Optimization Mode selection. These choices combine a frequency and group delay response to optimize the oscilloscope for particular applications.

- **Pulse Response** - A group delay compensation minimizing preshoot, this selection most resembles the response of an analog oscilloscope by controlling group delay to be slightly non-zero at the highest frequencies. In addition, a fourth-order Bessel frequency response is implemented.



- **Eye Diagram** - Flat group delay compensation resulting in equalized preshoot and overshoot. This selection improves the symmetry of serial eye diagrams. In addition, a fourth-order Bessel frequency response is implemented.

- **Eye Diagram HBR (High Bit Rate)** - same as Eye Diagram, but optimized for high bit rate signals (bit rate > ~2/3 oscilloscope bandwidth).



- **Flatness** - Flat group delay compensation with a brick-wall frequency response. While this provides the fastest rise time, there is also a slight penalty of more preshoot and overshoot compared to Eye Diagram mode. This selection is most often used in narrow-band RF measurements where it is desired to maintain constant magnitude response over the oscilloscope passband.
- **Flatness HBR (High Bit Rate)** - same as Flatness, but optimized for high bit rate signals (bit rate > ~2/3 oscilloscope bandwidth).

LabMaster 9 Zi-A Channel Setup

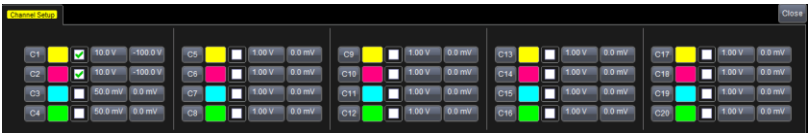
You can set up to 20 channels on the **Channel Setup** dialog. You can make adjustments to both the sensitivity and the positioning of the waveforms.

Setting up your channels

1. Press the appropriate channel push button (channel 1, for example).

   OR

   Touch **Vertical → Channel Setup...** from the menu bar.



2. Touch inside the checkbox next to a channel to display the trace.

> **NOTE:** Whenever you turn on a channel, a trace descriptor label is displayed for that channel.

3. To adjust sensitivity and position, turn the **VERTICAL GAIN** front panel knob for the selected channel.

   OR

   Touch inside the **Volts/Div** field next to the channel and enter a value. Click the **keypad** button to enter a value using the pop-up keypad, or use the up/down arrows.

> **NOTE:** The set voltage is shown on the trace descriptor label and in the Volts/Div field in the dialog.

4. To set the offset, turn the **VERTICAL OFFSET** adjust front panel knob directly above the channel button whose waveform you want to move vertically. Or, you can touch inside the **Offset** field next to the channel and type in a value on the pop-up keypad. To set the vertical offset to zero, touch the **Zero Offset** button directly below the **Offset** field.

5. To change the color assigned to a channel, click on the color box and choose a color.

> **NOTE:** Front panel knobs can be used to adjust Vertical Offset and Gain for channels 5-20, provided the trace descriptor label is active for the corresponding channel.

LabMaster De-Skew Calibration

The ChannelSync™ architecture in LabMaster modular oscilloscope systems utilizes a single 10 GHz distributed clock for all acquisition modules. This provides precise timing alignment and timing accuracy between all channels in all acquisition modules as found in a single, conventional oscilloscope package. However, to ensure that the static skew of all connecting cables is accounted for, a calibration is required for the most accurate results.

De-Skew calibration eliminates:

- Static skew due to minor differences in length of PCIe interconnection cables. LabMaster modular oscilloscopes may consist of multiple acquisition modules. These multiple modules need to deskewed with respect to each other to account for connection cable propagation delay (static skew). This propagation delay is normally 100-200 ps and is a result of the very small differences in length between the PCIe cables used for connections on your particular LabMaster setup.
- Minor static skew differences between channels and gain settings in a single acquisition module.
- The small amount of static skew remaining after the factory hardware deskew. At the factory, channels in each Acquisition Module are deskewed in hardware to within approximately 2 ps at 20 GHz. This can vary slightly over varying gain ranges (V/div settings) on each channel. Depending on the timing accuracy desired for your measurements and the bandwidth of your acquisition module, you may need to correct for this.
- Static skew introduced by probe and cable connections. With probes and cables connected to the acquisition module, additional static skew will be introduced. When these devices are attached, deskew signals must be respectively deskewed to each other is again required to eliminate the propagation delay of the signal due to these items being added to the signal path.

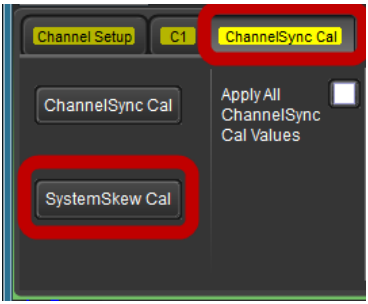
There are two different deskew calibrations that can be performed. Both permit quick and easy deskew of all of the channels in all LabMaster acquisition modules by automatically deskewing all channels to a user-designated reference channel, with the common deskewed reference plane being the input channel connectors on the acquisition module. A very high level of accuracy is maintained by using a fast reference signal and averaging for precision.

SystemSkew Cal

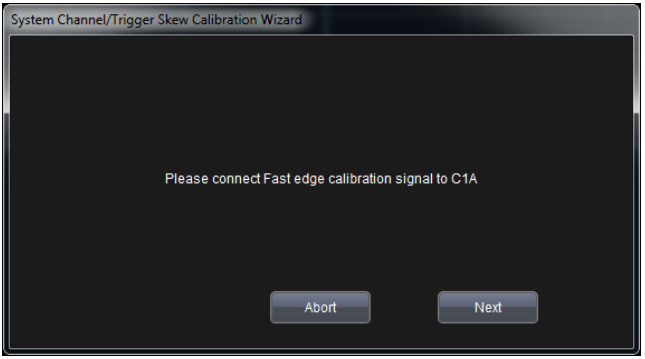
For a given LabMaster setup consisting of more than one acquisition module, this calibration provides the fastest and easiest way to eliminate the static skew caused by all PCIe interconnection cables and align trigger positions on all modules. The SystemSkew Cal need only be performed once at initial setup as long as the cables or the acquisition modules do not change. If the LabMaster system you're using has only one acquisition module, a SystemSkew Cal provides no value.

During SystemSkew Cal, you are instructed to connect the Fast Edge output to one channel on each acquisition module in a prescribed manner. All static skew adjustments are saved in a calibration folder. The values for this static skew calibration are not displayed in the ChannelSync Cal dialog. If the LabMaster system on startup detects a configuration change (e.g. a different serial number acquisition module connected to a certain PCIe slot), a pop-up dialog will appear warning the user to perform a new SystemSkew Cal.

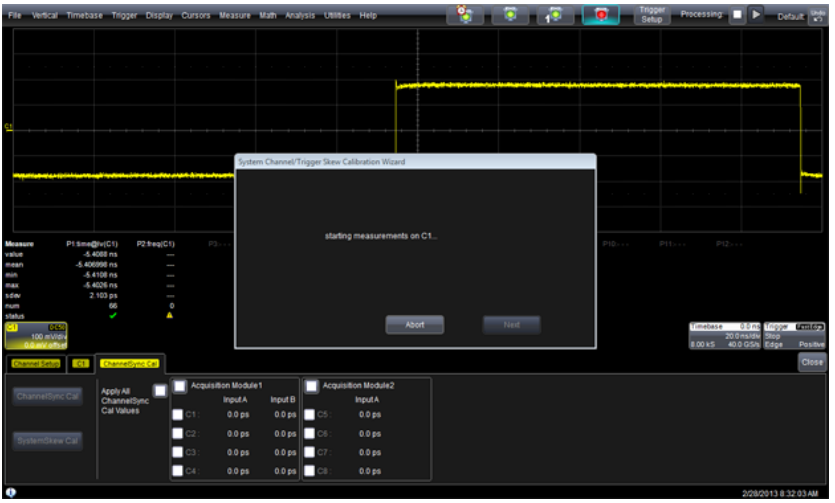
1. From the menu bar, choose **Vertical > Channel <#> Setup**. Touch the **ChannelSync Cal tab** to the right of the C<#> tab.



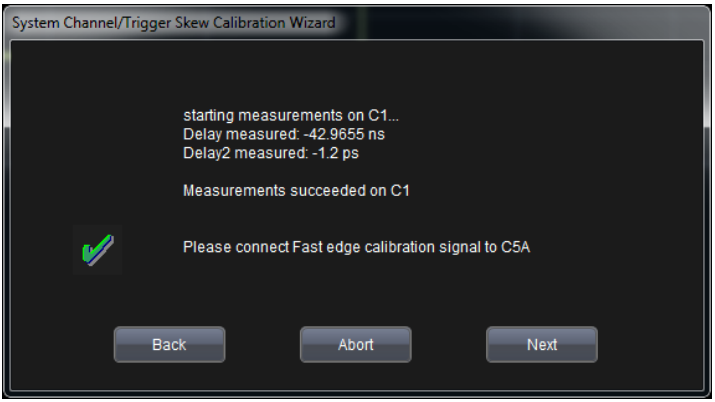
2. Touch the **SystemSkew Cal** button. The System Channel/Trigger Skew Calibration Wizard opens.



3. **Connect the Fast Edge output** on the front of the Master Control Module **to Channel 1**, then on the Wizard touch **Next**. The Fast Edge output will be displayed on Channel 1 during the operation.



4. When the previous operation is complete, you will be prompted to use the same cable as used to connect to Channel 1 to **connect the Fast Edge output to Channel 5**. After connecting, touch **Next** again.



5. Continue following on-screen prompts for as many additional modules there are.

6. When completed, touch **Finish** to apply and store all corrections.

ChannelSync Cal

This calibration method is most common and is used to eliminate minor static skew (<2 ps) differences between channels or to account for the addition of cables or probes between the signal and oscilloscope input channel. When Channel Sync Cal is complete, jitter between all channels is adjusted to a level comparable to a single conventional oscilloscope package , or better than 275 fs RMS.

NOTE THE FOLLOWING about ChannelSync Cal prior to performing the procedure:

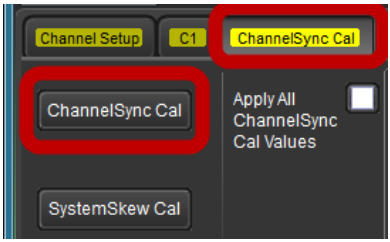
- ChannelSync Cal can be performed on different gain settings by using an attenuator (that you supply) to reduce the amplitude of the Fast Edge output. Choose an attenuator value that provides for a Fast Edge signal amplitude of ~4 to 7 divisions.
- If you perform ChannelSync Cal only on the 100 mV/div gain range, there is no need to enter a “Reference Correction” (attenuator propagation delay value).

- If you perform ChannelSync Cal on multiple gain settings, perform it first on the 100 mV/div setting, then perform it on other gain settings (with “Reference Correction” values entered as appropriate for those other gain settings.)
- For the highest possible accuracy across the full input range of the oscilloscope, a ChannelSync Cal should be performed on at least one gain setting in each of the following gain ranges:

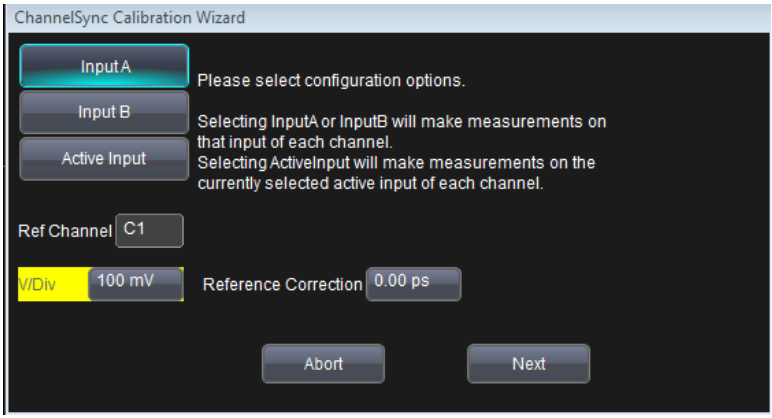
13-20 GHz ProLink "A" Inputs	30-45 GHz 2.92mm or 2.4mm "B" Inputs
<11.8 mV/div	10 mV/div
11.9 to 17.0 mV/div	10.1 to 12.6 mV/div
17.1 to 20.5 mV/div	12.7 to 15.8 mV/div
20.6 to 30.0 mV/div	15.9 to 20.0 mV/div
30.1 to 39.6 mV/div	20.1 to 25.0 mV/div
39.6 to 50.0 mV/div	25.1 to 31.5 mV/div
50.1 to 90.0 mV/div	31.6 to 39.5 mV/div
90.1 to 100.0 mV/div	39.6 to 50.0 mV/div
100.1 to 118.0 mV/div	50.1 to 63.0 mV/div
118.1 to 170.0 mV/div	63.1 to 79.0 mV/div
170.1 to 205.0 mV/div	79.1 to 82.0 mV/div
205.1 to 300.0 mV/div	82.1 to 100.0 mV/div
300.1 to 395.0 mV/div	100.1 to 126.0 mV/div
395.1 to 500.0 mV/div	126.1 to 158.0 mV/div
500.1 to 900.0 mV/div	158.1 to 200.0 mV/div
900.1 to 1000 mV/div	200.1 to 250.0 mV/div

- If you add cables or probes to your setup subsequent to running the ChannelSync Cal, you must manually deskew these items in the Channel dialog to account for their propagation delays. The values you provide on the Channel dialog (in the deskew section) are additional to values shown on the ChannelSync Calibration dialog.

1. From the menu bar, choose **Vertical > Channel <#> Setup**. Touch the **ChannelSync Cal tab** to the right of the C<#> tab.



2. Place a **checkmark next to the module(s) you want to calibrate** and touch the **ChannelSync Cal** button. The ChannelSync Calibration Wizard opens.



3. Select to measure **Input A** or **Input B**, or select **Active Input** to make measurements on the active input of each channel.

4. Select a **Ref Channel** to be used as a reference against which all other measurements are made during your calibration.

5. Enter the **V/div (gain) setting** for which you want to perform the ChannelSync Cal on all channels. The default value is 100 mV/div, which corresponds to the Fast Edge output amplitude.

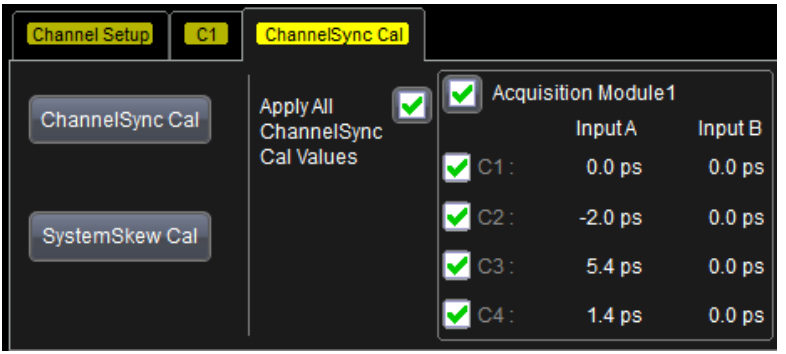
> **NOTE**: Connect the Fast Edge calibration signal (located on the front of the Acquisition Module) to the reference input channel (in this example, C1), then touch the Next button. The ChannelSync™ Cal begins.

As with System Skew calibration, you will see the Fast Edge output signal appear on the display and delay (skew) measurements will be made.

6. **Connect your Fast Edge** calibration signal to the **next input** (in this example, C2), then touch the **Next** button.

   Repeat Step 7 for each channel. As each channel is calibrated, its trace descriptor appears under the grid display area.

7. When you have finished all channels, a message indicates all measurements have been performed. Touch the **Finish** button. The ChannelSync™ Calibration dialog shows details about all performed measurements and the deskew values applied.



If you wish to perform additional ChannelSync calibrations on other gain settings, repeat the process from Step 5 with a different gain (V/div) setting and a Reference Correction value entered for that attenuator.

Trigger

NOTE: Channels 1-4 have complete triggering capability for Edge, SMART and other triggers. Channels 5 or higher have more limited edge trigger bandwidth and do not support SMART or other triggers. Refer to LabMaster specifications on teledynelecroy.com for details.

Triggering is the way an oscilloscope selects an exact moment in time on a signal to then be shown on the screen. If the pattern of a signal happens to be repetitive, a continuous waveform pattern is inherently visible on the display.

But without a regular signal pattern, the oscilloscope requires controls to determine what specific point in time (when a trigger is met) to show the signal on the display. This is accomplished and affected in a variety of ways.

Some trigger settings allow for pre-trigger, post-trigger, and a delay between the time of the trigger event and the time when the display is refreshed (or sweeped) and the waveform is again shown on the screen.

The instrument uses many waveform capture techniques that trigger on features and conditions that you define. These triggers fall into the following major categories:

- **Simple Triggers** - activated by basic waveform features or conditions such as a positive or negative slope, and hold-off
- **SMART Triggers** - sophisticated triggers that enable you to use basic or complex conditions for triggering. Use SMART Triggers for signals with rare features, like glitches.
- **Measurement Trigger** - triggers that allow you to leverage parameter measurements as waveform trigger conditions. A measurement trigger is either the only trigger or the final trigger in a chain of trigger events including hardware triggers.
- **MultiStage Triggers** - varied forms of triggers including **Cascaded**, **QualFirst**, and **Qualified** allowing varied combinations of triggers and trigger stages.
- **Serial Triggers** - provide serial data protocol specific triggering for a wide variety of standards.

Trigger Types

There are a set of standard Trigger Types. These Triggers are basic waveform features or conditions such as a positive or negative slope, and hold-off and are available on all oscilloscopes along with tools like **Software Assisted Trigger** and **Trigger Scan**.

In addition, there are more sophisticated triggers for setting basic or complex conditions. These include **Smart Triggers**, **Serial Trigger**, **Measurement Triggers**, and **MultiStage Triggers**.

Learn more and **Contact Teledyne LeCroy for Support**.

Edge

A simple trigger, Edge trigger is activated by basic waveform features or conditions such as positive or negative slope, and holdoff.

NOTE: On **WaveMaster 8 Zi** and **Zi-A** and **LabMaster** 9 **Zi-A**, up to 15 GHz bandwidth is available while Edge Triggering (provided no holdoff is selected).

Width

Width trigger allows you to define a positive- or negative-going pulse width bounded by a voltage level, above or below an occurring trigger. Or you can specify a pulse width and voltage range, within or outside an occurring trigger.

Pattern (Logic)

Logic trigger enables triggering on a logical combination (pattern) of five inputs: CH1, CH2, CH3, CH4, and AUX (sometimes referred to as EXT on legacy oscilloscope models). You have a choice of four Boolean operators (AND, NAND, OR, NOR), and you can stipulate the high or low voltage logic level for each input independently.

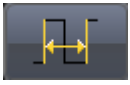
Smart

These are a specific set of sophisticated trigger types. Smart trigger types are used to set conditions on signals with rare features, like the glitches and others as follows:

WINDOW

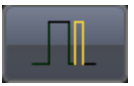
A smart trigger occurs when a signal enters or exits a window defined by adjustable thresholds.

INTERVAL



While Glitch trigger performs over the width of a pulse, **Interval** trigger performs over the width of an interval - the signal duration (the period) separating two consecutive edges of the same polarity: positive to positive or negative to negative. Use interval trigger to capture intervals that fall short of, or exceed, a given time limit. In addition, you can define a width range to capture any interval that is itself inside or outside the specified range - an Exclusion trigger by interval.

GLITCH



Glitch trigger is a simpler form of Width trigger. Use Glitch trigger when you want to define a fixed pulse-width time or time range only. Glitch trigger makes no provision for voltage levels or ranges.

DROPOUT

Used primarily in single-shot applications, and usually with a pre-trigger delay, **Dropout** trigger can detect lost signals. The trigger is generated at the end of the timeout period following the last trigger source transition.

RUNT

The **Runt** trigger occurs when a pulse crosses a first threshold line, but fails to cross a second threshold line before re-crossing the first. Other defining conditions for this trigger are the edge (triggers on the slope opposite to that selected) and runt width.

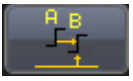
SLEW RATE

SlewRate trigger activates a trigger when the rising or falling edge of a pulse crosses two threshold levels: an upper level and a lower level. The pulse edge must cross the thresholds faster or slower than a selected period of time.

Measurement

This trigger type allows you to leverage parameter measurements as waveform trigger conditions. A measurement trigger is either the only trigger or the final trigger in a chain of trigger events including hardware triggers.

MulitStage

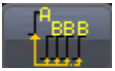


Touching this **MultiStage** trigger type shows the additional MultiStage types on the dialog. Select from **Cascaded**, **QualFirst**, and **Qualified** as follows:

CASCADED

The Cascaded trigger allows you to define successive trigger **Stages** (referred to as Stage **A**, **B**, **C**, and **D**) as **arm**, **trigger/arm**, **trigger/arm**, **trigger** criteria, respectively.

QUALFIRST



In single trigger mode, **QualFirst** arms the oscilloscope on the A event, and then triggers on all subsequent B events.

NOTE: This button is enabled when using the sequence sampling mode. It is commonly used in sequence mode for disk drive applications with the index pulse defined as the A qualifier signal and the servo gate signal as the B triggering events.

QUALIFIED A-B

In single trigger mode, **Qualify A-B** arms the oscilloscope on the A event, and then triggers on the B event. If the oscilloscope is in Normal trigger mode, it automatically resets after the B event. Arm trigger events can be set for **Edge**, **Pattern**, **State**, and **PatState**. State is briefly explained as follows:

State

The **State** trigger is a level-qualified trigger which requires that the qualifying signal remain above or below a specified voltage level for a trigger to occur. For State trigger, you specify the time or number of events after the signal has gone above or below the voltage level when you want the trigger to occur.

Serial Trigger

Protocol-enabled serial trigger capabilities are available as options on several oscilloscope models.

Trigger Settings

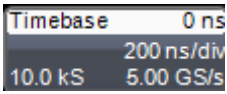
Horizontal and Vertical adjustments are typically made for all trigger types using either the **Delay** or **Level** knobs on the front panel of the instrument or their respective controls on the **Timebase** setup dialog.

- **Horizontal**: Turn the **DELAY** knob in the HORIZONTAL control group to adjust the trigger's horizontal position. Or, touch inside the **Delay** control and provide a value on the **Timebase** dialog using your preferred input control method. Additional information on using the touch screen controls can be found in the **Dialog Area** (on page 87).

  The trigger location is shown by a marker under the grid.

  Post-trigger delay is indicated by a left-pointing arrow at the lower-left of the grid.

  The time value is given in the title line of the **Timebase** label at the lower-right of the grid.

- **Vertical:** Turn the **LEVEL** knob in the TRIGGER control group to adjust the trigger's vertical threshold.

  Turn this knob to adjust the level of the trigger source or the highlighted trace. Level defines the source voltage at which the trigger will generate an event: a change in the input signal that satisfies the trigger conditions.

  Alternatively, in the Trigger dialog, you can touch inside the **Level** control and provide a value using your preferred input control method. Additional information on using the touch screen controls can be found in the **Dialog Area** (on page 87). Quickly set a level of zero volts by touching the **Zero Level** button.

  An arrow on the right side of the grid shows the threshold position. This arrow is only visible if the trigger source is displayed.

Trigger Setup

Based on your **Trigger Type** selection, sections of the main Trigger dialog and additional dialogs altogether vary.

Most trigger types have **Type**, **Setup**, and **Level** selections. The following sections explain some of the standard setup configurations for different trigger types.

1. Make your **Type** selection by touching the button corresponding to the desired trigger.

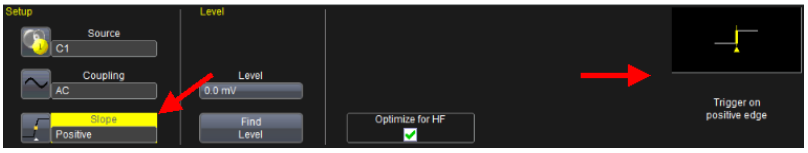
2. Touch inside the trigger **Source** control for your first **Setup** configuration and select a source on which to trigger.

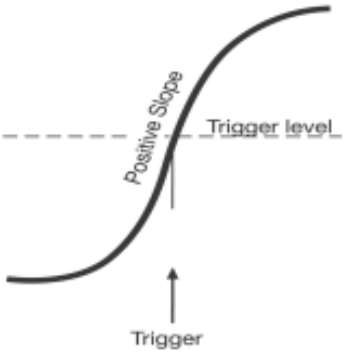
3. If available, touch inside the **Coupling** control and select a coupling mode.

Coupling refers to the type of signal coupling at the input of the trigger circuit. Choices of trigger coupling vary by oscilloscope model. With DC coupling, all of the signal's frequency components are coupled to the trigger circuit for high-frequency bursts.

4. Touch inside the trigger **Slope** control and choose the direction of the trigger voltage transition used for generating a particular trigger event.

The selection is then shown to the right of the dialog as follows for a Positive Slope selection on an Edge Trigger.





Edge trigger works on the selected edge at the chosen level. The slope (positive or negative) is specified on the Trigger label shown at the lower-right of the grid.

5. **Level** defines the source voltage at which the trigger circuit generates an event (a change in the input signal that satisfies the trigger conditions). The selected trigger level is associated with the chosen trigger source.

Note that the trigger level is specified in volts and normally remains unchanged when the vertical gain or offset is modified.

The Amplitude and Range of the trigger level have limits detailed in the specifications regularly maintained at teledynelecroy.com.

Touch inside the **Level** data entry control and provide a value using your preferred input control method. Additional information on using the touch screen controls can be found in the **Dialog Area** (on page 87).

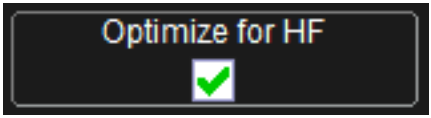
Provide a voltage level (in millivolts).

PLEASE NOTE THE FOLLOWING:

- Once specified, Trigger Level and Coupling are the only parameters remaining unchanged as you switch from trigger mode to trigger mode for each trigger source.
- Some additional controls and dialogs for triggers that differ are provided in the following topics as examples.

Optimize for HF

The Optimize for HF checkbox can be used on an **Edge** trigger to reject high or low frequencies.



The checkbox is marked by default; meaning, the instrument is optimized for high-frequency waveforms.

NOTE: If you are measuring a waveform that is 10 MHz or slower, be sure to unmark the checkbox to avoid triggering on an incorrect slope.

Width Condition is

Width triggers (and other triggers equipped with conditional logic) have conditional logic settings as follows.

Your **Width Condition** can be specified as **Less Than**, **Greater Than**, **In Range** and **Out Of Range**.

In Range and **Out Of Range** conditions can be further set with **Upper** and **Lower Values** (for **Limits**).

OR

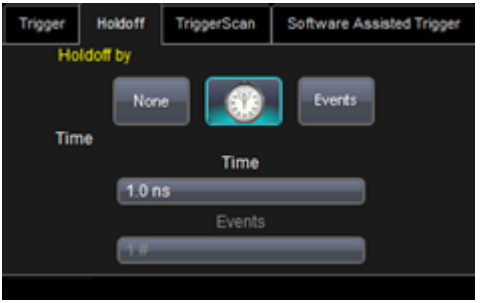
Nominal width and **Delta** (for **Delta**).

NOTE: Width Condition settings are summarized on the far right of the dialog.

Holdoff by Time or Events

Holdoff is an additional condition of Edge and Pattern triggers. It can be expressed either as a period of **time** or an **event** count. Holdoff disables the trigger circuit for a given period of time or number of events after the last trigger occurred. Events are the number of occasions on which the trigger condition is met. The trigger resumes when the holdoff has elapsed and its other conditions are met.

Select the holdoff by touching the **Time** or **Events** buttons on the **Holdoff** dialog.

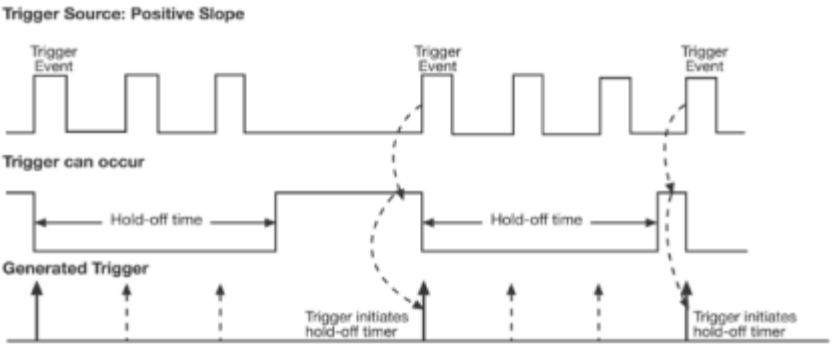


Now, click the corresponding control and provide a value.

Use holdoff to obtain a stable trigger for repetitive, composite waveforms. For example, if the number or duration of sub-signals is known you can disable them by choosing an appropriate holdoff value. Qualified triggers operate using conditions similar to holdoff.

HOLD OFF BY TIME

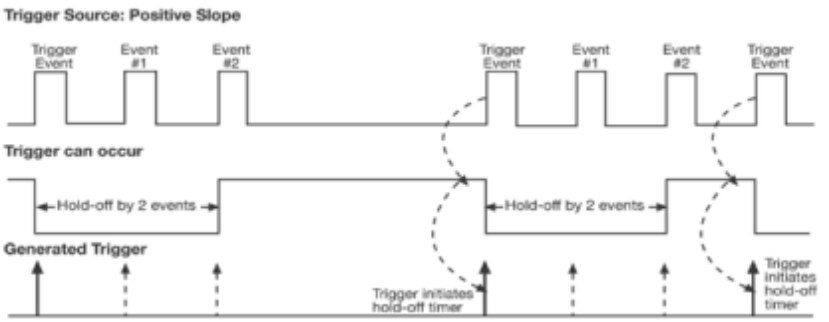
Sometimes you can achieve a stable display of complex, repetitive waveforms by placing a condition on the time between each successive trigger event. This time would otherwise be limited only by the input signal, the coupling, and the instrument's bandwidth. Select a positive or negative slope, and a minimum time between triggers. The trigger is generated when the condition is met after the selected holdoff time, counted from the last trigger. The delay is initialized and started on each trigger.



Edge Trigger with Holdoff by Time. The bold edges on the trigger source indicate that a positive slope has been selected. The dashed, upward-pointing arrows indicate potential triggers that would occur if other conditions are met. The bold arrows indicate where the triggers actually occur when the holdoff time is met.

HOLD OFF BY EVENTS

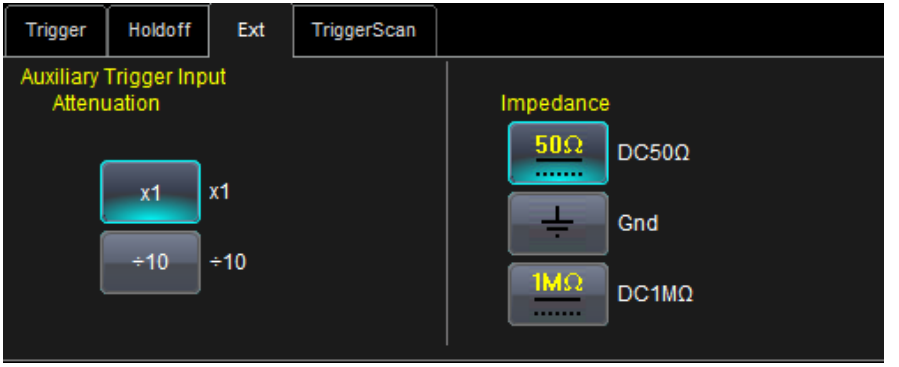
Select a positive or negative slope and a number of events. An event is the number of times the trigger condition is met after the last trigger. A trigger is generated when the condition is met after this number, counted from the last trigger. The count is restarted on each trigger. For example, if the event number is two, the trigger occurs on the third event.



Edge Trigger with Holdoff by Events (in this example, two events). The bold edges on the trigger source indicate that a positive slope has been selected. The dashed, upward-pointing arrows indicate potential triggers, while the bold ones show where triggers actually occur after the holdoff expires.

Auxiliary Input Trigger

Some instrument models provide auxiliary input trigger capability. It's done as a pattern trigger, on the **Ext** dialog.



Select **X1**, or **÷10**. You can also select from **DC50Ω**, **Gnd**, and **DC1MΩ Impedance** values.

TriggerScan

TriggerScan is a debugging tool (available for any trigger type) that helps you quickly find rare waveform glitches and anomalies. With TriggerScan, you can build a list of trigger setups to look for rare events and automatically sequence through each one. TriggerScan can use any type of trigger setup available including edge, width, and qualify as well as Smart Triggers (such as, glitch and runt triggers). TriggerScan automates two key processes in triggering rare events:

1. Trains the system by looking at normal acquired waveforms. During the training, the oscilloscope analyzes the waveforms to determine what waveforms normally look like. Using this information, it generates a list of smart trigger setups to trigger on abnormal situations.

2. Loads the smart trigger setups from the Trainer and cycles through these. As triggers occur, they are overlaid on the screen. All acquisition settings are preserved and you can use all the functions of the oscilloscope to find the root cause of these anomalies including, WaveScan, Histograms, and advanced analysis.

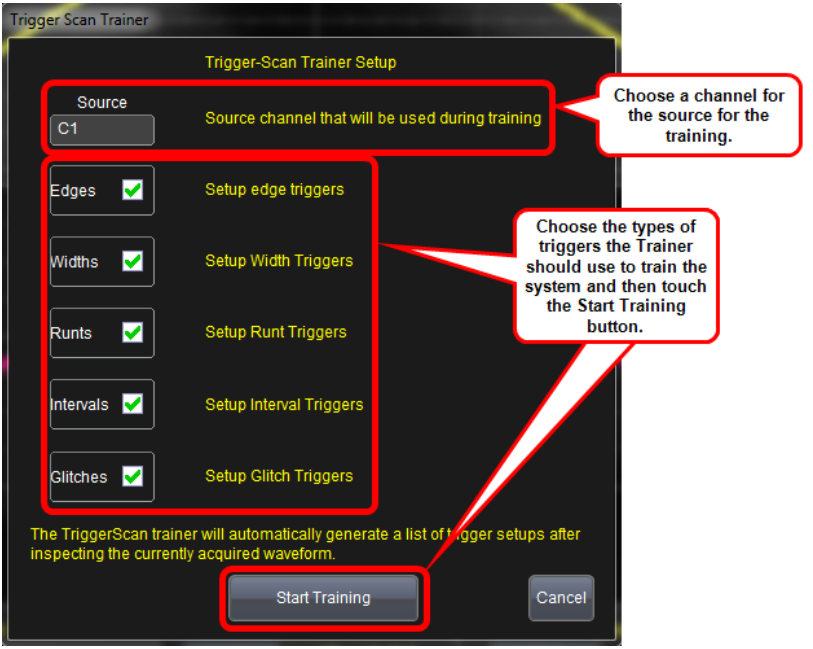
Training TriggerScan

The TriggerScan Trainer inspects a currently acquired waveform and automatically builds a list of common trigger setups used to find rare events. To train TriggerScan:

- Acquire and display at least three cycles of a signal before running the Trainer.
- Re-run the Trainer if you want to change the trigger types or if you change the channel or signal.

1. Touch **Trigger → Trigger Setup...** from the menu bar.
2. On the **Trigger** dialog, click the **TriggerScan** tab.
3. Touch the **Trainer** button and select a channel as the source for the training on the **Trigger Scan Trainer** pop-up. Also choose the types of triggers the Trainer should use to train the system and then touch the **Start Training** button. The training begins.

   When it is complete, a list of smart trigger setups is displayed in the Trigger List.


Trigger Scan Trainer
Trigger-Scan Trainer Setup
Source
C1
Source channel that will be used during training
Choose a channel for the source for the training.
Edges
Setup edge triggers
Widths
Setup Width Triggers
Runts
Setup Runt Triggers
Intervals
Setup Interval Triggers
Glitches
Setup Glitch Triggers
Choose the types of triggers the Trainer should use to train the system and then touch the Start Training button.
The TriggerScan trainer will automatically generate a list of trigger setups after inspecting the currently acquired waveform.
Start Training
Cancel

Starting TriggerScan

After you have run the Trainer, the Trigger List displays a list of smart trigger setups. You can add or remove trigger setups. You can also update the selected smart trigger setup. Once you have made any changes to the Trigger List, you are ready to start scanning.

1. Touch **Trigger → Trigger Setup...** from the menu bar.
2. On the **Trigger** dialog, click the **TriggerScan** tab and its corresponding dialog is shown.

3. If you want to add a new trigger setup, touch the **Trigger** tab and set the new trigger as desired on the **Trigger** dialog. Then, back on the **TriggerScan** dialog, touch the **Add New** button to append the new trigger to the **Trigger List**.
4. If you want to replace the selected trigger setup with the current trigger setup, highlight the setup in the Trigger List and touch the **Update Selected** button.
5. If you want to show a specific trigger setup on the Trigger List, highlight its corresponding row on the list, and then touch the **Load Selected** button.

> **NOTE:** If you want to delete all trigger setups in the Trigger List, touch the Delete All button.

6. If you want to delete a trigger setup, highlight the setup in the Trigger List and touch the **Delete Selected** button.
7. All trigger setups can be deleted regardless of selections on the Trigger List with one step by touching the **Delete All** button.

5. Once you have made any changes to the Trigger List, touch the Trainer button and then restart the scan by touching the **Start Training** button on the Trigger Scan Trainer pop-up. The oscilloscope automatically sequences through all the trigger setups.

PLEASE NOTE THE FOLLOWING:

- You can tune the dwell time that the oscilloscope waits before loading the next trigger setup using the Dwell Time data entry control.
- If you have Persistence display mode enabled, all trigger events are recorded on the display. Refer to the Persistence Setup (on page 149) topic for instructions on enabling Persistence display mode.
- If you want TriggerScan to stop when the next oscilloscope trigger, check the Stop On Trigger checkbox. You can use this to isolate specific trigger setups.

Saving TriggerScan Setups

You should save TriggerScan setups once you have made any modifications to the Trigger List. The current Trigger List is not be preserved after exiting the application unless you save it.

1. On the **TriggerScan** dialog, touch inside the **Setup File Name** data entry control and providing a file name using your preferred input control method. Additional information on using the touch screen controls can be found in the **Dialog Area** (on page 87).

   OR

   Touch the **Browse** button and select a location and file name.
2. Touch the **Save Setup...** button.

NOTE: You can load previously saved TriggerScan setups by touching the Browse button, locating the file, and then touching Load Setup....

Viewing Waveforms

Display

Oscilloscope display grids present the trace information in a voltage vs. time format. The oscilloscope analog-to-digital converter (ADC) information is displayed vertically on the grid with the ADC bits divided proportionally according to their amplitude on the grid. Channel traces are typically 8-bits of vertical data, whereas Math traces are 16-bits of vertical data. Teledyne LeCroy grids consist of eight vertical divisions.

When displaying channel traces on the grid, use of less than full-grid amplitude results in some reduced vertical resolution and accuracy. For instance, if a channel trace is displayed as two divisions high on a grid, the number of ADC bits utilized is...

*2/8 * 2^8 or 64 bits*

This is quite less than the full 8-bit resolution. Such a reduction in vertical resolution may be acceptable if the primary measurement consideration is for rough timing measurements; however, if vertical accuracy or extreme timing accuracy is a requirement, it is better to increase the amplitude of the signal to utilize close to maximum grid height. In order to accomplish this while still providing the ability to view many signals at one time on the oscilloscope display Teledyne LeCroy provides **multi-grid** capability. This creates multiple oscilloscope grids, each with 8-bit vertical resolution, and allows many full-resolution grids (but vertically smaller in grid height) for concurrent display without affecting the vertical resolution.

Different grid displays are available based on instrument and installed software packages. For example, some displays show side-by-side, instead of vertically stacked grids. The additional grid displays offer more convenient views of multiple waveforms. Refer to your instrument datasheet at teledynelecroy.com for detailed information as to which grid displays are provided with your oscilloscope.

Display Setup

To adjust the appearance of the oscilloscope display:

1. Touch **Display → Display Setup**.
2. Touch **Grid** and select one of the display type buttons. The image on each button indicates its corresponding grid configuration.

   Autogrid automatically adds or deletes grids as you select more or fewer waveforms to display.

   NOTE: Not all grid styles are available on all instruments. Grid styles vary based on both oscilloscope model and installed options.

   See “Touch Screen and External Displays” (page 61) for steps to extend the grid display onto a second monitor.
3. To dim or brighten the grid lines, touch **Grid Intensity** and enter a percentage from 0 to 100.
4. Touch the **Grid on top** checkbox to superimpose the grid over the waveform.

   NOTE: Depending on the grid intensity, some waveforms may be hidden when the grid is placed on top. To view them, simply uncheck Grid on top**.**
5. Touch the **Axis labels** checkbox to permanently display the values of the top and bottom grid lines (calculated from volts/div) and the extreme left and right grid lines (calculated from the timebase).
6. Choose a style for your trace: solid **Line** or **Points**.
7. To highlight trace samples that occur with most frequency, touch **Intensity** and enter a percentage from 0 to 100. Samples occurring less often than the intensity value are dimmed.

Sequence Mode Display

Set up a Sequence Mode display by first selecting a **Sequence** trigger mode in the **Timebase → Horizontal Setup** dialog. You must also have entered a **Num Segments** value. For more information on setting up Sequence Mode, see the **Sequence Sampling Mode** (on page 101) topic.

1. Touch **Display → Display Setup...** on the menu bar.
2. Touch inside the **Display Mode** control and select a display mode from the pop-up menu.

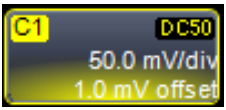
   Touch inside the **Num seg displayed** control and enter a value, using the pop-up keypad.

   Touch inside the **Starting at** control and enter a value.

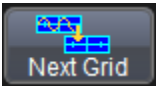
Moving Traces from Grid to Grid

You can move traces from grid to grid with the touch of a button.

1. Touch the trace descriptor label for the waveform you want to move.



2. Touch the **Next Grid** button.



NOTE: If you have more than one waveform displayed on only one grid, a second grid automatically opens when you select **Next Grid**.

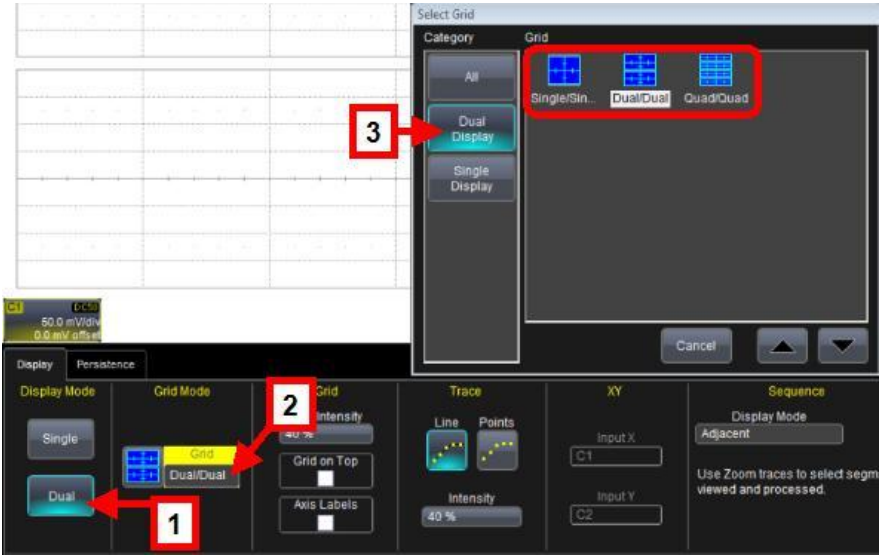
Displays Containing Masks

Since masks are pixel-based display renderings, you can think of them as part of the Display feature set on your instrument. Masks and mask testing are applied to waveforms as part of **Pass/Fail** functionality accessed from **Analysis → Pass/Fail** from the menu bar.

NOTE: For more detailed information about Masks and other Pass/Fail functionality, such as removing a mask from your display, refer to **Mask Testing** (on page 188).

Dual Display Grid Selection

Make a dual grid display selection for showing on an external display (once properly connected to the I/O panel) by selecting **Display → Display Setup...**.



NOTE: First-time setup may show a different Display tab. Fix this by touching File → Exit on the menu bar and re-launching the oscilloscope software using the Start DSO shortcut on the desktop.

1. Touch the **Dual** button on the Display Mode section of the Display dialog.
2. Touch inside the **Grid** control on the Grid Mode section of the dialog. The **Select Grid** pop-up is shown.
3. Touch the **Dual Display** category and choose from **Single/Single**, **Dual/Dual**, and **Quad/Quad** options.

Your grid selection is now shown on both displays.

Persistence

Persistence Overview

The Persistence feature helps you display your waveform and reveal its idiosyncrasies or anomalies for a repetitive signal. Use Persistence to

accumulate on-screen points from many acquisitions to see your signal change over time. The instrument persistence modes show the most frequent signal path in three-dimensional intensities of the same color, or graded in a spectrum of colors.

You can show persistence for up to eight inputs for any channel, math function, or memory location (M1 to M4).

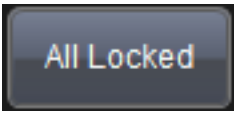
Persistence Setup

Touch **Display → Persistence Setup...** on the menu bar.

Now, touch the **Persistence On** checkbox and refer to the following scenarios based on your needs.

Persistence Setup for All Input Channels at Once

1. Touch the **All Locked** button.



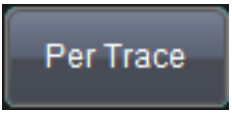
2. Touch one of the **Mode** buttons.

3. Touch the **Show last trace** checkbox if you want the last trace displayed.
4. Touch inside the **Saturation** data entry control and provide a whole number integer.

   For more information on saturation, see the **Saturation Level** topic.
5. Touch inside the **Persistence time** data entry control and make a selection from the pop-up menu.

Persistence Setup for Each Input Channel Individually

1. Touch the **Per Trace** button.



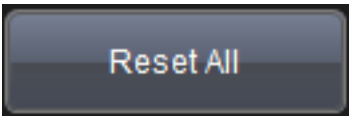
2. Touch one of the **persistence mode** buttons next to an input channel.

To turn off persistence for an individual channel, touch the left-most persistence mode button next to the channel.
OR

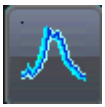
For each input channel, touch its tab to set up persistence for that channel.

3. Touch one of the **mode** buttons.

4. Touch the **Show last trace** checkbox if you want the last trace displayed.
5. Touch inside the **Saturation** data entry control and enter a whole number integer,.
6. Touch inside the **Persistence time** data entry control and make a selection from the pop-up menu.
7. If you want to return all input channel setups to their default settings, touch the **Reset All** button.



WaveStream Display Mode



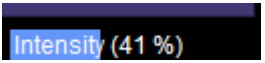
This fast viewing mode provides brightness-graded intensity with a decay time similar to the action of phosphor on an analog screen.

WaveStream mode operates at up to 80 GS/s with an update rate of up to several thousand waveforms/second for better capture of higher frequency abnormal events.

Adjusting Trace Intensity

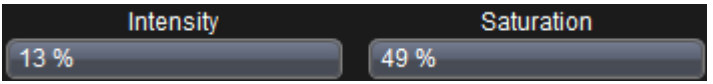
The **INTENSITY** knob adjusts the brightness of your trace.

The intensity value is shown in the bottom-right corner of the screen.



Pushing the **Intensity** knob changes the Persistence status in the following ways.

- **OFF** - When the button hasn't been pushed, it may be turned to control the trace **Intensity** control value.
- **Analog Persistence** - When the button is pushed once, the waveform resembles a trace on a phosphor oscilloscope. Turning the knob affects persistence with a blended form of **Intensity** and **Saturation**. As the knob is turned clockwise, the **Intensity** value increases while the **Saturation** value decreases. The opposite occurs when the button is turned counter clockwise.



- **Color Persistence** - The button behaves the same way as Analog. However, the grid display shows a color waveform where red indicates most frequent occurrences while blue denotes the less frequent.

Instead of using the knob, you can provide values for **Intensity** (same control on Display and Persistence dialogs) or **Saturation** controls.

Zooming Waveforms

Zooming Waveforms Overview

You can magnify a selected region of a waveform using the Zoom function. On Zi model oscilloscopes, you can display up to four Zoom (Z1 - Z4) and eight Math Zoom traces (F1 - F8). You can zoom:

- A single channel - covered in **To Zoom a Single Channel** (on page 154).
- **A math or memory trace** - known as **Zooming Memory or Math Function Traces**.
- **Multiple waveforms at once** - covered in **To Zoom Multiple Waveforms Quickly** (on page 156).
- **Segments in a sequence** - found in **Sampling Modes → Sequence Sampling Mode** (on page 101)

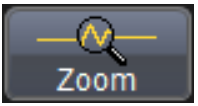
You can also use the Multi-Zoom Math function to create time-locked zoom traces for selected waveforms. For more information, refer to **Math → Multi-Zoom**).

At any time, you can zoom a portion of a channel waveform or Memory/Math function trace by touching and dragging a rectangle around any part of the input waveform, see the **To Zoom by Touch-and-Drag** (on page 156) topic. The zoom trace will size itself to fit the full width of the grid. The degree of magnification, therefore, will depend on the size of the rectangle that you draw.

You can also use the front panel **QUICKZOOM** button to create multiple zooms, one for each displayed input channel. For more information, see the **To Zoom Multiple Waveforms Quickly** (on page 156) topic.

When you zoom a waveform, a preview of the zoomed area is shown on the **Preview** section of the **Zx** dialog.

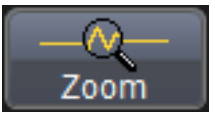
Zooming a Single Channel



The **Zoom** button appears as a standard button at the bottom of the channel **Cx Vertical Adjust** setup dialog for you to create a zoom trace of your input waveform.

1. On the menu bar, touch **Vertical → Channel X Setup...**.
   OR
   Touch the channel trace descriptor label for a displayed channel.

2. Touch the **Zoom** at the bottom of the **Cx Vertical Adjust** dialog. A zoom trace (one of Z1 to Z4) is created for the selected channel.



3. Vary the degree of zoom by touching the newly created **Zx** trace label. The setup dialog for the zoom (Z1 to Z4) opens. It shows the current horizontal and vertical zoom factors.
4. If you want to increase or decrease your horizontal or vertical zoom in small increments, touch the **Var.** checkbox to enable variable zooming. Now with each touch of the zoom control buttons, the degree of magnification changes

by a small increment.

OR

If you want to zoom in or out in large standard increments with each touch of the zoom control buttons, leave the **Var.** checkbox unchecked.

OR

If you want to set exact horizontal or vertical zoom factors, touch inside the Horizontal **Scale/div** data entry control and provide a time-per-div value using your preferred input control method. Additional information on using the touch screen controls can be found in the **Dialog Area** (on page 87). Then touch inside the Vertical **Scale/div** control and enter a voltage value.

To reset the zoom to x1 magnification, touch **Reset Zoom** in the dialog.

You can also use the Zoom and Math front panel knobs to adjust the horizontal and vertical zoom.

- **Horizontal Position** - Press to reset the horizontal zoom position to zero. Turn to change the horizontal position of the selected math or zoom trace.
- **Horizontal Ratio** - Press to toggle between fixed and variable horizontal zoom ratio adjustment. Turn to change the horizontal zoom ratio of the selected math trace.
- **Quick Zoom** - Press to automatically display magnified views of up to four signal inputs on multiple grids. With four input signals, the signals are displayed along with four zoom traces, each on its own grid. Pressing this button also turns off all other traces.
- **Vertical Position** - Press to reset the vertical zoom position to zero. Turn to change the vertical position of the selected math or zoom trace.
- **Vertical Ratio** - Press to toggle between fixed and variable vertical zoom ratio adjustment. Turn to change the vertical zoom ratio of the selected math trace.

Touch-and-Drag Zooming

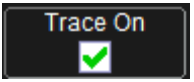
1. Touch and drag a rectangle around any part of an input channel waveform, math trace, or memory trace. The **Zoom** (Z1 to Z4) dialog opens.

   NOTE: If you have enclosed a combination of channel and math or memory traces in the rectangle, a pop-up Rectangle Zoom Wizard is shown. Touch a Zoom button (Z1 to Z4).

2. Turn off the zoom traces by touching the **Undo** button at the top-right corner of the screen.

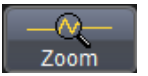
   OR

   Uncheck the **Trace On** checkbox in the dialog for each zoom trace.

Quickly Zooming Waveforms

Quickly create a Zoom trace by either pressing the front panel **Zoom** button or touching the Zoom button on the respective channel dialog.



Turning Off Zoom

Turn off a Zoom by either pressing the front panel **Zoom** button again, or clearing the Trace On checkbox on the Zoom dialog.

Measuring with Cursors

Cursors are important tools that aid you in measuring signal values. Cursors are markers - lines, cross-hairs, or arrows - that you can move around the grid or the waveform itself. Use cursors to make fast, accurate measurements and eliminate guesswork. There are two basic types:

- **Horiz(ontal)** (generally Time or Frequency) cursors are markers that you move horizontally along the waveform. Place them at a desired location along the time axis to read the signal's amplitude at the selected time.
- **Vert(ical)** (Voltage) cursors are lines that you move vertically on the grid to measure the amplitude of a signal.

Each cursor locates a point on the waveform. The cursor values can be read in the descriptor label for the trace. Use the **Position** data entry controls at the right side of the dialog to place the cursors precisely. The **Readout** icons depict what is being measured for each measurement mode.

Quickly Displaying Cursors

Quickly turn on/off cursors from either the touchscreen or the Front Panel:

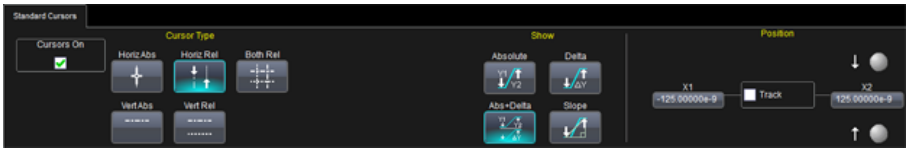
- On the display, touch Cursors on the menu bar and make a selection. **Off, Horizontal Abs, Horizontal Rel, Vertical Abs, Vertical Rel,** and **BothRel** options are available on the menu.
- On the Front Panel, press the Cursor Type button repeatedly to scroll through all the cursor types available on your instrument. With the desired cursor type selected, turn the Cursors knobs to adjust the position of the cursor.

PLEASE NOTE THE FOLLOWING:

- The bottom cursor knob adjusts relative cursors. It does not work with absolute cursor types.
- Once set, cursor positions are preserved for subsequent displays. Use the touch screen or front panel controls to change cursor positions or measurement modes.

Cursor Setup

After using one of the above methods to access cursors, the **Cursors** dialog is displayed.



Cursor Types

- **Horizontal Abs** - Provides a single, dashed, vertical line and cross-hair marking for the specific cursor location. None of the **Show** controls are provided; however, the Position 1 control is enabled on the right of the dialog.
- **Horizontal Rel** - Provides two, dashed, vertical lines and cross-hair markings for the specific cursor locations. Since there are two cursors involved, controls for **Show** along with **Track**, and **Position 1** and **2** are available on the dialog.
- **Vertical Abs** - Provides a single, dashed, horizontal line and cross-hair marking for the specific cursor location. None of the **Show** controls are provided; however, the Position 1 control is enabled on the right of the dialog.
- **Vertical Rel** - Provides a single, dashed, horizontal line and cross-hair marking for the specific cursor location. None of the **Show** controls are provided; however, the Position 1 control is enabled on the right of the dialog.
- **Both Rel** – Provides both Horizontal Rel and Vertical Rel cursor lines.

Show (for Relative Cursor Types)

Show controls (**Absolute**, **Delta**, **Abs+Delta**, and **Slope**) become available on the dialog when Relative Cursors (**Horizontal** or **Vertical Rel** cursor types) are chosen.

For **Horizontal** and **Vertical Rel** cursor types, you can also specify **Position 1** and **2** time values for your cursor locations. You also have the option to mark the **Track** checkbox which allows you to move your Position 1 cursor (using the touch-screen display or front panel control) and have both

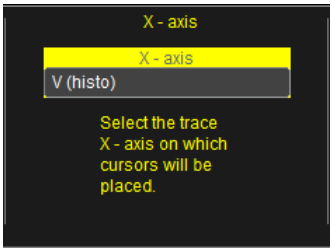
cursors then move together and maintaining their relative distance from their originally specified positions.

The **Show** controls essentially display cursor value results on the signal's corresponding **Trace Descriptor** label as follows:

- **Absolute** - The Trace Descriptor label shows **specific voltages** for the position location values provided.
- **Delta** - The Trace Descriptor label shows the **difference between the specific voltages** for the position location values provided.
- **Abs+Delta** - The Trace Descriptor label shows both the **specific voltages** and the **difference between the specific voltages** for the position location values provided.
- **Slope** - The Trace Descriptor label calculates the **slope** based on the position location values provided.

Cursors on Math Functions

You can place cursors on a math function whose X-axis has a dimension other than time (FFT, for example). With a Math trace setup for either an FFT or a Histogram, if you then access the **Standard Cursors** dialog (**Measure → Cursors Setup...**) , an **X-Axis** control is made available where you can choose from available units. The following shows cursors on a histogram and therefore an appropriate selection for **V (histo)** is available.



Measurement Parameters

Parameters are measurement tools that determine a wide range of waveform properties. Use them to automatically calculate many attributes of your waveform, like rise-time, rms voltage, and peak-to-peak voltage, for example.

There are parameter modes for the amplitude and time domains, custom parameter groups, and parameters for pass and fail testing. You can make common measurements on one or more waveforms.

Turning On Parameters

1. Touch **Measure → Measure Setup...** on the menu bar.
2. Touch the **On** checkbox for each parameter you want to enable.
3. Touch the **Show Table** checkbox to display the parameters below the grid.

Quick Access to Parameter Setup Dialogs

You can quickly gain access to a parameter setup dialog by touching the parameter listbox in the table below the grid.

For example, touch within **P1** to display the P1 setup dialog.

Touch the Measure column on the table display to show the main **Measure** dialog.

Parameter Setup

1. Touch the parameter tab (**Px**) of an unused location or one that you want to change.
2. Under **Type**, select a measurement type:

Measure On Waveforms applies measurements directly on the waveform as indicated on the **Source1** control.

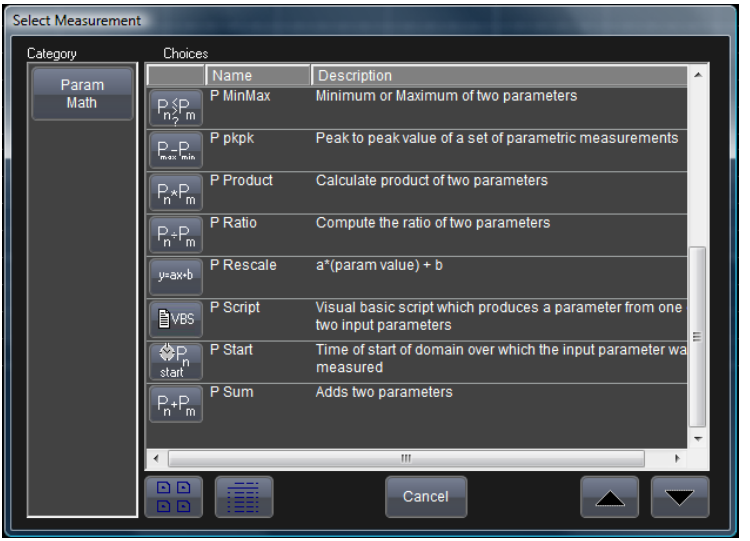
Math On Parameters performs math (addition, subtraction, multiplication, division) on parameters indicated on the **Source1** and **Source2** controls.

Advanced Web Edit uses Teledyne LeCroy's Processing Web for measurement setup. This feature, available with the XWEB option, allows you to chain practically unlimited math functions together for operation on your waveform measurements.

3. Touch inside the **Source1** field and select a channel, math trace, memory trace, or other waveform to be measured.
4. If you selected **Measure On Waveforms**, touch inside the **Measure** field and select a parameter from the pop-up menu.

OR

If you selected **Math On Parameters**, touch inside the **Math Operator** data entry field and select a math function from the pop-up menu.



5. In the mini-dialog to the right of the main setup dialog, touch the **Gate** tab to narrow the span of measurement.
6. Touch the **Accept** tab to define parameter values to be used in the measurement.

Measure Modes

The selections for Measure Mode allow you to quickly apply parameters for **standard vertical** and **standard horizontal** setups, and custom setups.

Standard Vertical Measurement Parameters							
mean	**sdev**	**max.**	**min.**	**ampl**	**pkpk**	**top**	**base**

Standard Horizontal Measurement Parameters							
freq	**period**	**width**	**rise**	**fall**	**delay**	**duty**	**num points**

To select a measure mode:

1. Touch **Measure → Measure Setup...** on the menu bar.
2. Under **Measure Mode**, select the **Std Vertical** or **Std Horizontal** buttons.

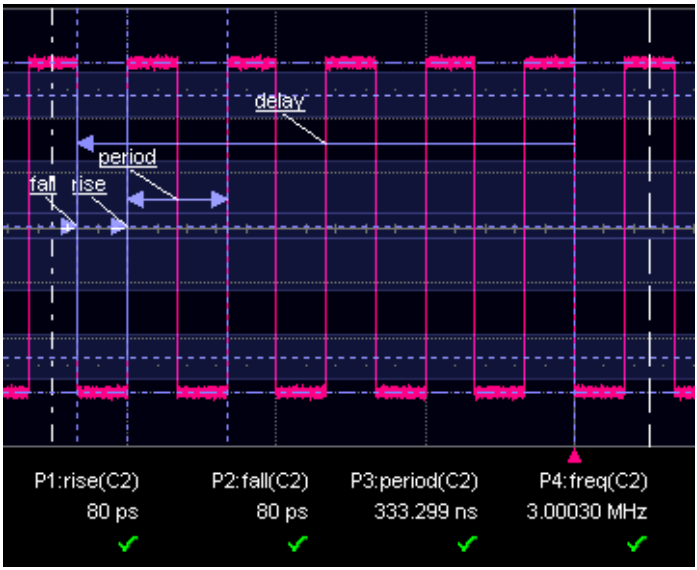
> **NOTE**: You can customize parameters by touching My Measure. Learn more in Customizing a Parameter (on page 1).

3. Touch inside the **Source** data entry control and choose a source for which the measurements should apply.

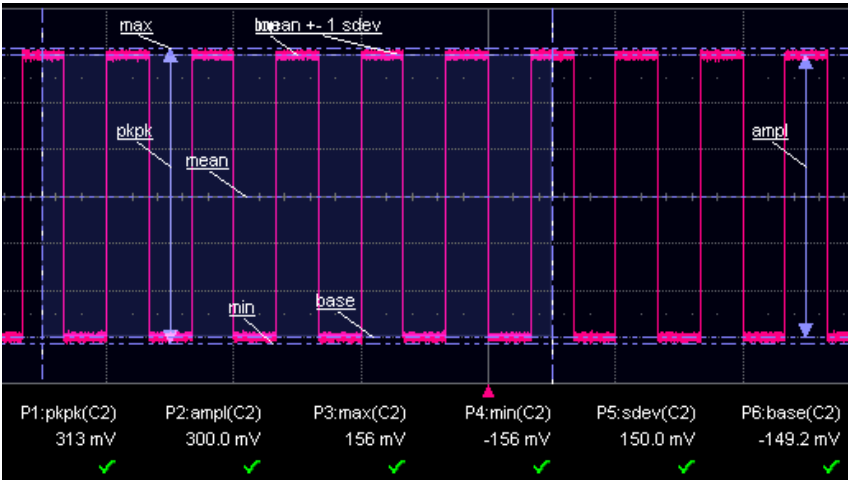
Help Markers

Help Markers clarify parameter measurements by displaying movable cursors and a visual representation of what is being measured. For the **at level** parameters, Help Markers make it easier to see where your waveform intersects the chosen level. This feature also displays the hysteresis band that you have set about that level.

You also have the option, by means of an **Always On** checkbox, to leave the Help Markers displayed after you have closed the Help Markers setup dialog.



Standard Horizontal Parameter Help Markers



Standard Vertical Parameter Help Markers

Turning On Markers

1. Touch **Measure → Measure Setup...** on the menu bar.
2. Select mode **Std Vertical**, **Std Horizontal**, or **My Measure**.
3. Touch the **Show All** button (as follows) to display Help Markers for every parameter being measured on the displayed waveform (C2 in the previous examples).
4. Touch a **Px** tab for any listed parameter; it doesn't matter which.
5. On the Parameter dialog, touch **Help Markers** and select either:
   - **Simple** - produces cursors and Measure Gate posts. The gate posts are independently placeable for each parameter.
   - **Detailed** - produces cursors, Measure Gate posts, a label identifying the parameter being measured, and a level indicator and hysteresis band for "at level" parameters.

   NOTE: The choice of Simple or Detailed is applied to all parameters at the same time. That is, if you choose Simple markers for one parameter, all parameters are then displayed in this mode.
6. Touch the **Always On** checkbox if you want to continuously display Help Markers for this parameter.

Turning Off Markers

1. Touch the **Clear All** button to turn off Help Markers for all parameters.
2. Turn off Help Markers for individual parameters by touching the **Px** tab for the parameter in question. Then uncheck the **AlwaysOn** checkbox. When you close this dialog, the Help Markers for this parameter are no longer shown.

Analysis

Teledyne LeCroy provides a variety of unique capabilities for advanced measurement parameter analysis. Most Teledyne LeCroy oscilloscopes calculate measurements for all instances in the acquisition. This provides the ability to rapidly and thoroughly analyze a long memory acquisition and calculate thousands or millions of parameter values, or find anomalous measurements. A variety of views are then provided allowing quick and easy measurement value understanding, as follows:

- **Histograms** provide a view of the measurement parameter distribution.
- **Tracks** provide a time-correlated view of a measurement parameter compared to other acquired channels or calculated math traces. A common usage for track is to observe the modulation of a signal, such as amplitude, frequency, or pulse width modulation. See **Creating a Track View** (on page 175).
- **Trends** provide a view of the measurement parameter over an extended period of time and over multiple acquisitions. See **Creating and Viewing a Trend** (on page 174).
- **Pass/Fail Testing** (on page 176) allows definition of the normal or abnormal measurement parameter value with a definable pass/fail action alerting the operator when a condition is met.
- **WaveScan** allows searching through a single acquisition for a measurement parameter that meets a variety of conditions, or scanning through multiple acquisitions with allowable trigger actions when conditions are met. In addition, a variety of views can be used to understand the specific behaviors of searched or scanned measurement parameters. See **Introduction to WaveScan** (on page 192).

These capabilities are only possible with the measurement of every occurrence of a measurement parameter in a long acquisition.

Both Track and Trend are tools that can be used to plot measurement data and observe variations with respect to time. Differences between

Track and Trend are summarized in the following table:

Characteristic	Track	Trend
Representation	Parameter value vs. time	Parameter value vs. event
Behavior	Non-cumulative (resets after every acquisition). Unlimited number of events	Cumulative over several acquisitions up to 1 million events
Time Correlation to Other Data	Yes	No
Monitors an Evolution in the Frequency Domain	Yes	No. Trend points are not evenly spaced in time and therefore cannot be used for an FFT.
Monitors the Evolution of a Measurement Parameter over Several Acquisitions	No. Track resets after every acquisition.	Yes
Ensures No Lost Measurement Data	Yes. Maximum time period that can be captured is limited by acquisition memory and sampling rate.	No. Since data can be accumulated over many acquisitions, and since the oscilloscope takes time to calculate measurement values and to display data before the trigger is re-armed, data can be missed.

In general, Track is the tool to use if you want to capture a continuous stream of data spaced closely together. To understand the change in a parameter with time, Trend can be used if your data is spaced widely apart and longer than the dead-time of the oscilloscope between acquisitions. Think of Trend as a strip chart recorder for your oscilloscope.

Histogram

Histograms are graphical representations of data which divides it into intervals or bins. These intervals/bins are plotted on a bar chart such that the bar height relates to the number of data points inside each interval/bin. Various histograms can be setup using **Measure** or **Math** dialogs. Thumbnail versions of Histograms are called **Histicons**. Also, **Persistence** can be applied to Histograms.

PLEASE NOTE THE FOLLOWING:

- The number of sweeps comprising the histogram is shown on the trace descriptor label:

- The range of a histogram is limited to the portion of the trace that is visible on screen. That is, if you zoom in on a trace, the histogram does not contain data for that part of the original (no longer visible) trace.

Single Parameter Histogram Setup

Setup a single parameter histogram can be done from **Measure** or **Math** dialogs. The following sections demonstrate both methods.

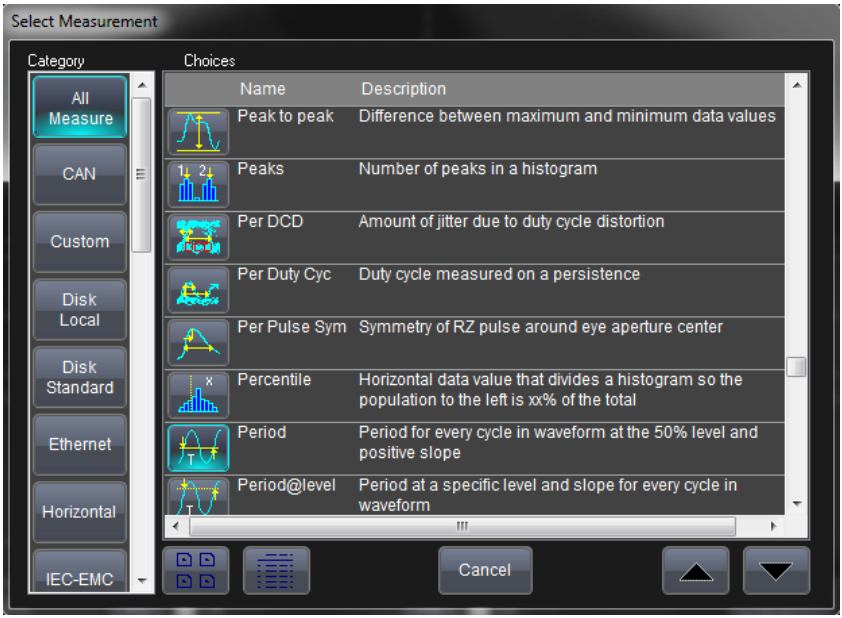
SINGLE PARAMETER HISTOGRAM SETUP USING MEASURE

Touch **Measure → Measure Setup...** on the menu bar to access the **Measure** dialog. The **My Measure** button should be selected by default on the **Measure** dialog.

There are two ways to access parameters when setting up your measurement. They only differ in the order of the steps.

- Use the **Px buttons** on the Measure Dialog
- Use the **Measure** button on a Px Dialog

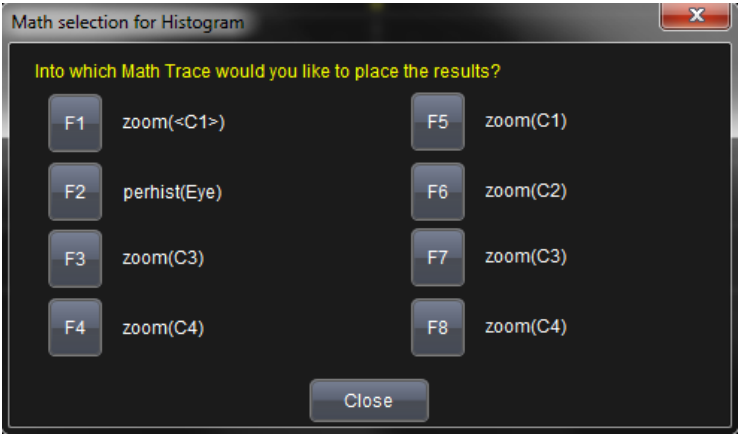
Choose the parameter from the Select Measurement pop-up dialog.



The Select Measurement pop-up.

Access the corresponding **Px** dialog to change other setup items as follows:

1. Touch inside the **Source1** control and select an input waveform from the **Select Source** window.
2. Touch inside the **Measure** field and select a parameter from the **Select Measurement** window.
3. Touch the **Histogram** button at the bottom of the dialog. After touching this button, the **Math selection for Histogram** pop-up is shown. Select the desired **Math Trace** in which to store the results. Touch the **Close** button when you are finished.



Touch the **trace descriptor label** for the math trace just created for the results, and then touch the **Histogram** tab to access its right-hand dialog.

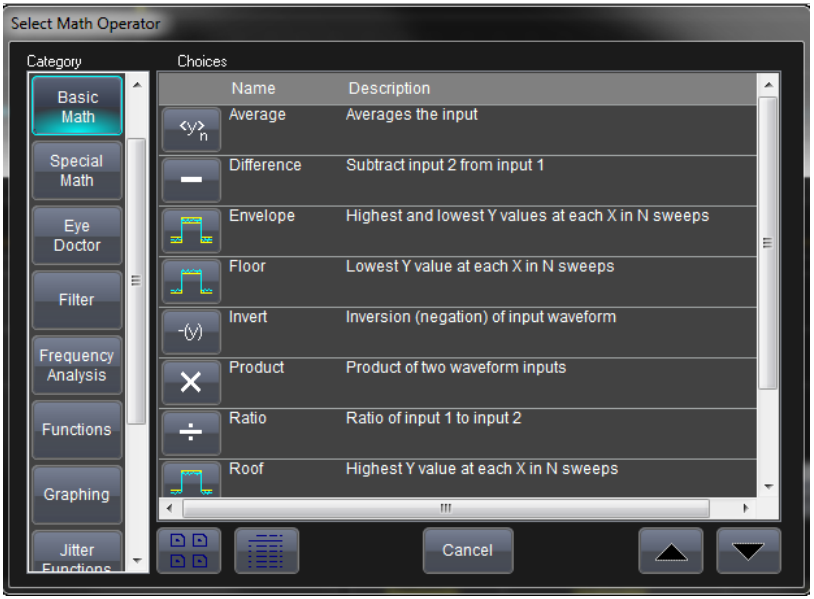
1. On the **Buffer** side of the **Histogram** right-hand dialog, touch **#Values** and provide a value.
2. On the **Scaling** side of the **Histogram** right-hand dialog, touch **#Bins** and provide a value.
3. Center the histogram by touching the **Find Center and Width** button.
4. Instead of using the **Find Center and Width** button, you can provide specific **Center** and **Width** values using their respective controls and providing values using the pop-up numeric keypad.

Single Parameter Histogram Setup Using Math

Access the main Math dialog by selecting **Math → Math Setup...** on the menu bar.

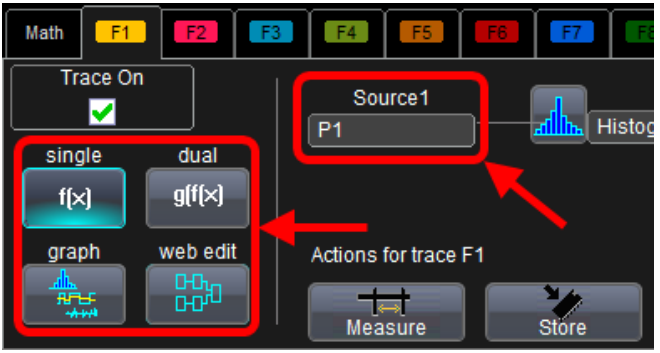
Access the math operators by either:

- Using the Fx buttons on the Math Dialog
- Using the Operator button on the Fx Tab/Dialog



Math functions are categorized into Basic and Special.

Regardless of how you performed the previously described initial steps, at this point access your corresponding **Fx** dialog if you want to change other setup items as follows:



- You can modify the source of your waveform used on a Math trace using the **source (Source 1)** control.
- On the far left of the Fx dialog, the single and dual buttons are available for one math function or math-on-math, respectively.
- The **web edit** button is used to access the Processing Web and sequence highly-detailed math functionality.
- Touch the **Graph** button, and then touch inside the **Graph with** control to select a graph mode (in this case **Histogram**).

At this point, access the Histogram right-hand dialog by touching the Histogram tab on the far-right of the screen. Follow the final 1 - 4 steps in the previous **Single Parameter Histogram Setup Using Measure** instructions.

Viewing Thumbnail Histograms (Histicons)

Histicons are miniature histograms of parameter measurements that appear below the grid. These thumbnail histograms let you see at a glance the statistical distribution of each parameter.

1. On the menu bar, touch **Measure**, then one of the Measure Mode buttons: **Std Vertical**, **Std Horizontal**, or **My Measure**.
2. Touch the **Histicons** checkbox to display thumbnail histograms below the selected parameters.

NOTE: For measurements set up in My Measure, you can quickly display an enlarged histogram of a thumbnail histogram by touching the Histicon you want to enlarge. The enlarged histogram appears superimposed on the trace it describes. This does not apply to **Std Vertical** or **Std Horizontal** measurements.

Persistence Histogram

You can create a histogram of a persistence display also by cutting a horizontal or vertical slice through the waveform. You also decide the width of the slice and its horizontal or vertical placement on the waveform.

NOTE: This math operation is different than the Histogram math operation and is not affected by **Center** and **Width** settings made on any existing Histograms.

PERSISTENCE HISTOGRAM SETUP

1. Touch **Math → Math Setup...** on the menu bar.
2. Either directly touch an **Fx** button on the Math dialog and select your Math Operator, or touch an **Fx** tab to show its corresponding dialog and touch the Operator1 dialog to select your Math Operator. Select **Phistogram** from the **Select Math Operator** pop-up.

3. With your math operator selected and the Fx dialog shown, touch inside the **Source1** field and select a source from the pop-up.
4. Touch the **Phistogram** tab to access its right-hand dialog. Now, touch the **Slice Direction** control and select **Horizontal** or **Vertical** slice from the pop-up.

5. Touch inside the **Slice Center** field and enter a value using the pop-up keypad.
6. Touch inside the **Slice Width** field and enter a value, using the pop-up keypad.

Persistence Trace Range

Using this math operator, you can enter the percent of the persistence trace population to use in creating a new waveform.

NOTE: See previous sections for details around setting up a math trace and selecting your math operator if needed.

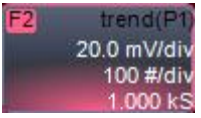
Persistence Sigma

Using this math operation, you can enter a scale, measured in standard deviations, by which to create a new waveform.

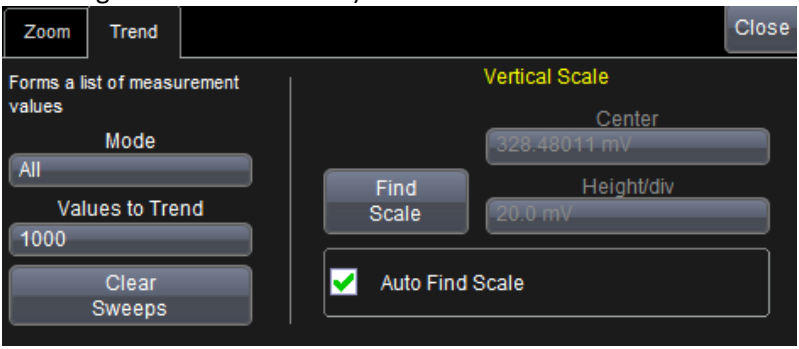
Creating and Viewing a Trend

1. In the menu bar, touch **Measure → Measure Setup...**.
2. Touch one of parameter tabs **Px** showing its corresponding dialog.
3. Now, on the dialog, touch inside the **Source1** data entry field and select an input waveform from the pop-up menu.
4. Touch inside the **Measure** data entry field and select a parameter from the pop-up menu.
5. Touch the **Trend** button at the bottom of the dialog.

Now, from the **Math selection for Trend** menu, select a math function location **Fx** in which to store the **Trend** display. The Trend is then shown along with its respective trace descriptor label for the selected math function.



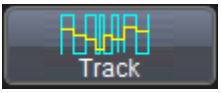
6. Touch the newly displayed Trend math function trace label to change settings on the Trend dialog (located on the Trend tab at the lower-right side of the screen).



NOTE: Turning off a trace for which trend data is being collected resets the trend. If it is necessary to continue data collection for the trend, first create a zoom trace of the channel trace (before turning off the channel trace).

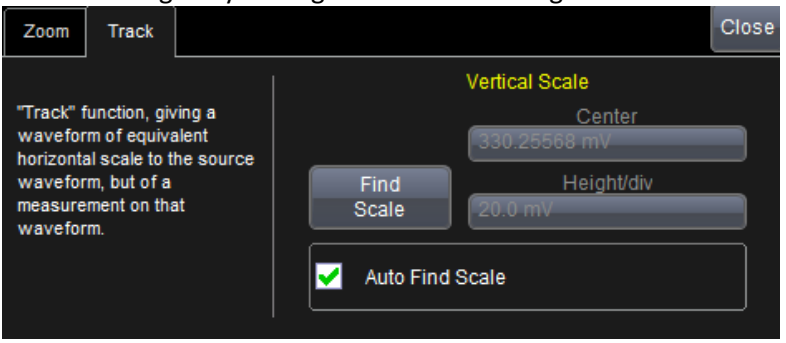
Creating a Track View

1. In the menu bar, touch **Measure → Measure Setup...**.
2. Touch a parameter tab **Px** and its corresponding dialog is shown.
3. Now, on the dialog, touch inside the **Source1** data entry field and select an input waveform from the pop-up menu.
4. Touch inside the **Measure** data entry field and select a parameter from the pop-up menu.
5. Touch the **Track** button at the bottom of the dialog.



Now, from the **Math selection for Track** menu, select a math function location (**Fx**) on which to store the Track display. The Track is then shown along with its respective trace descriptor label for the selected math function.

6. Touch the newly displayed Track math function trace label if you want to change any settings in the **Track** dialog:



Pass-Fail Parameter Testing

Pass/Fail Parameter Testing Overview

Access the main **Pass/Fail** dialog by selecting **Analysis → Pass/Fail Setup...** from the menu bar. The main **Pass/Fail** dialog is shown.

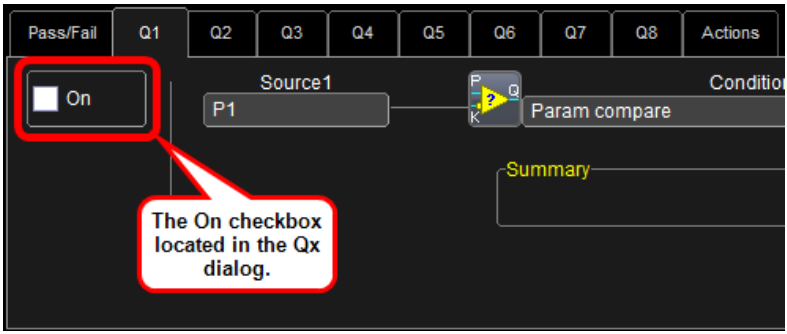
Access the respective **Qx** dialogs either by touching a **Qx** button on this main Pass/Fail dialog, or touching a **Qx** tab as described in **Displays Containing Masks** (on page 147).

When you have each of the **Qx** dialogs configured and enabled as desired, you can then begin your testing and turn them all on or off using the **Testing** checkbox on the main Pass/Fail dialog. You can also specify Actions for all or some of your conditions using the Actions dialog.

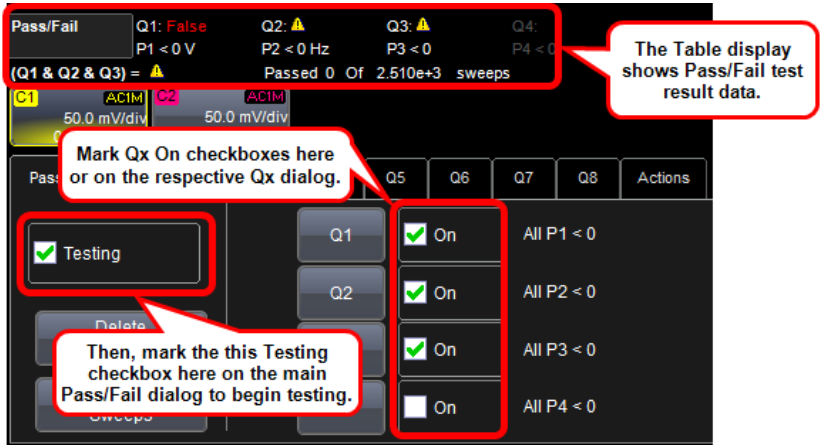
Testing and Enabling Pass/Fail Conditions

Beside each Qx button on the main Pass/Fail dialog is a corresponding Qx checkbox.

Use either these checkboxes or the ones on each respective **Qx** dialog to enable the specific condition for use.



When you have each of the **Qx** dialogs configured and enabled as desired, you can then begin your testing and turn them all on or off using the **Testing** checkbox on the main Pass/Fail dialog.



Your test data is shown on the Table display area shown in the previous screen-shot.

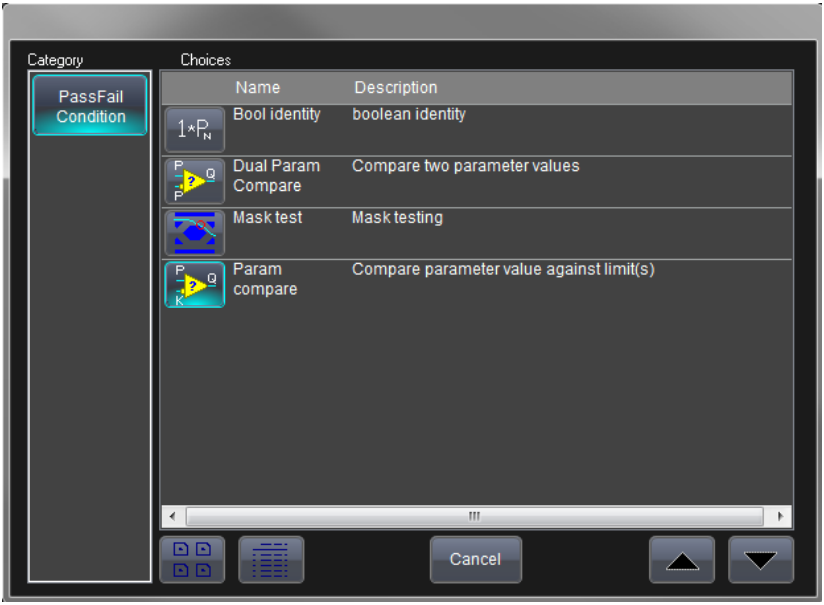
Pass/Fail Setup on Qx Dialogs

The Qx dialog contains several controls for specifying your Pass/Fail setup.

MAIN QX DIALOG CONTROLS

Use the **Source1** control to specify the waveform you'll use for your Condition.

Set your Pass/Fail condition by touching the **Condition** control on the corresponding Qx dialog. The Pass/Fail Condition pop-up is shown.



Select the desired condition.

NOTE: Right hand dialogs back on the corresponding Qx dialog vary based on the Pass/Fail condition selected.

The following sections cover the right hand dialogs for **Bool identity** and **Param and Dual Param Compare**. The **Mask test** condition is covered in **Mask Testing** (on page 188).

CONDITION-BASED RIGHT-HAND DIALOGS

The following provide some explanation about the different Conditions and their respective right-hand dialogs.

Boolean Identity

This condition simply passes the input values through as the desired result.

Param and Dual Param Compare

Using the Param Compare conditions, each Pass/Fail input (**Qx**) can compare a different parameter result to a user-defined limit (or statistical range) under a different condition.

Comparing a Single Parameter

1. With the ParamCompare condition selected on a Qx dialog, touch inside the **Compare Values** field and select **All** or **Any** from the pop-up menu.

   By selecting **All**, the test are true only if every waveform falls within the set limit. Selecting **Any** makes the test true if just one waveform falls within the limit.

2. Touch inside the **Condition** field on the **ParamCompare** part of the dialog and select a math operator from the pop-up menu.

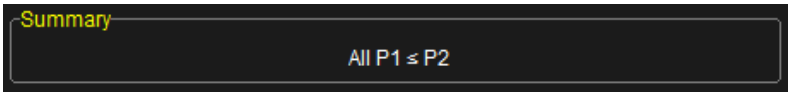
3. Touch inside the **Limit** field and enter a value using the pop-up numeric keypad. The value entered acquires the dimensions corresponding to the parameters being tested.

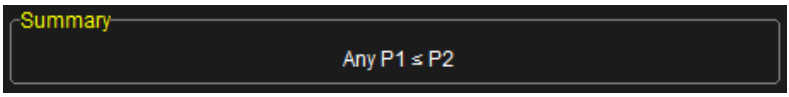
   For example, if you are testing a time parameter, the unit is seconds.

   If you choose either **WithinDeltaPct** or **WithinDeltaAbs** from the **Condition** menu (respectively, previous), you also have the choice of setting the limit by means of the statistical buttons (relating to standard statistical limits) at the bottom of the **ParamCompare** dialog:

Comparing Dual Parameters

In **Dual Parameter Compare** mode, your oscilloscope can take parameter results measured on two different waveforms and compare them to each other. If desired, set your test to be true if **Any** or **All** waveforms fit the criteria set by the comparison condition. Setups are conveniently shown in the Summary box of the **Qx** dialog as follows (shown on the Dual Param Compare right-hand dialog):





1. Touch **Analysis → Pass/Fail Setup...** from the menu bar.
2. Touch one of the **Qx** tabs and a setup dialog for the position is shown.
3. Touch inside the **Condition** field in the main dialog and select **DualParamCompare**.

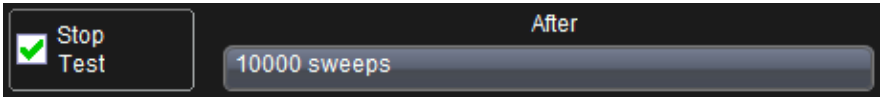
4. Touch inside the **Source1** and **Source2** fields and select a source from the pop-up menu.
5. Touch inside the **ParamCompare** mini-dialog field and select a source from the pop-up menu.
6. Touch inside the **Compare Values** field and select **All** or **Any** from the pop-up menu.

   By selecting **All**, the test are true only if every waveform falls within the set limit. Selecting **Any** makes the test true if just one waveform falls within the limit.
7. Touch inside the **Condition** field on the **ParamCompare** part of the dialog and select a math operator from the pop-up menu.
8. Touch inside the **Limit** field and enter a value, using the pop-up numeric keypad. This value takes the dimension of the parameter that you are testing. For example, if you are testing a time parameter, the unit is seconds.
9. If you choose either **WithinDeltaPct** or **WithinDeltaAbs** from the **Condition** menu respectively, touch inside the **Delta** field and enter a value.

The Actions Dialog

Various configurations can be made to all or some of your Pass/Fail conditions using the **Actions** dialog.

By touching the **Stop Test**checkbox in the **Actions** dialog, you can set up the test to end after a predetermined number of sweeps that you decide.



You can also decide the actions to occur upon your waveforms' passing or failing, by selecting one or all of the following:

- stop
- audible alarm
- print image of display
- emit pulse (if available)
- save waveform

The Pulse checkbox (shown right) causes a pulse to be output through the Aux Out connector at the front of the oscilloscope.

This pulse can be used to trigger another oscilloscope. You can set the amplitude and width of the pulse as described in Auxiliary Output Signals.

Depending on your oscilloscope model, you can configure up to 8 pass/fail conditions. The Boolean conditions to determine if your waveform passes are as follows:

Pass/Fail Boolean Conditions	
All True	All False
Any True	Any False
All Q1 to Q4 **Or** All Q5 to Q8	Any Q1 to Q4 **And** Any Q5 to Q8

PASS/FAIL TESTING SETUP

Initial Setup

1. Touch **Analysis → Pass/Fail Setup...** on the menu bar.
2. Touch the **Actions** tab.
3. Touch the **Enable Actions** checkbox. This causes selected actions to occur on your waveform's passing or failing a test.
4. Touch the **Summary View** checkbox to enable a line of text (as follows) showing a concise status of the last waveform and keeping a running count of how many sweeps have passed.

5. Touch inside the **Pass If** control, and select a Boolean condition from the choices shown.
6. If you want to set up the test to end after a finite number of sweeps, touch the **Stop Test** checkbox. Then touch inside the **After** data entry control and provide a value using your preferred input control method. Additional information on using the touch screen controls can be found in the **Dialog Area** (on page 87).
7. Use either the **Pass** or **Fail** button on the **If** section of the dialog to set actions taking place when your waveform passes or fails the test.

8. The **Then** section of the dialog provides **stop test**, **sound alarm**, **print result**, **emit pulse**, or **save** (the waveform) actions. If you want to

have the results printed (and your oscilloscope is not equipped with a printer) make sure your instrument is connected to a local or network printer. Learn more in the **Printing and Hardcopy Functions** topic (available in the online help files).

9. If you want to save your waveform automatically, touch the **Save Setup...** checkbox. This takes you out of the current dialog and opens the **Save Waveform** dialog. Learn more in the **Save Recall → Saving and Recalling Waveforms** topic (available in the online help files).
10. Test Pass/Fail conditions by touching the **Force Actions Once** button. Press the **Clear All** button to quickly uncheck all checkboxes and make new selections.

Math

Math Traces and Functions Overview

Teledyne LeCroy offers a deep toolset of math functions always growing and changing to provide superior functionality.

NOTE: To find out which math tools are available in each optional package or for any detailed explanations about specific functionality, check specifications regularly maintained on the Teledyne LeCroy website at teledynelecroy.com.

The extreme power of Teledyne LeCroy's math functions is most evident when used:

- to perform mathematical functions on waveforms displayed on any channel **Cx**.
- to perform mathematical functions on waveforms recalled from memory **Mx**.
- as a source input waveform **Fx** in order to perform computations in sequence.
- as parameters **Px**.

Instruments offering more than one math trace provide even more enhanced capabilities. For example:

- setting up Trace F1 as the difference between Channels 1 and 2
- having trace F2 provide the average of F1
- having trace F3 provide the integral of F2
- go even further and display the integral of the averaged difference between Channels 1 and 2.

You can even chain traces and/or functions to another trace or function. For instance:

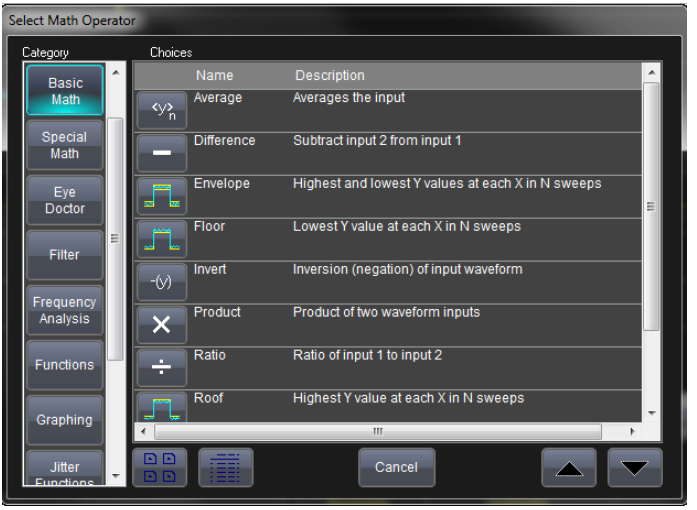
- making Trace F1 an average of Channel 1.
- making Trace F2 an FFT of F1.
- making Trace F3 a zoom of F2.

Math Setup

Access the main Math dialog by selecting **Math → Math Setup...** on the menu bar.

There are two ways to select your math operator during setup. They only differ in the order of the steps.

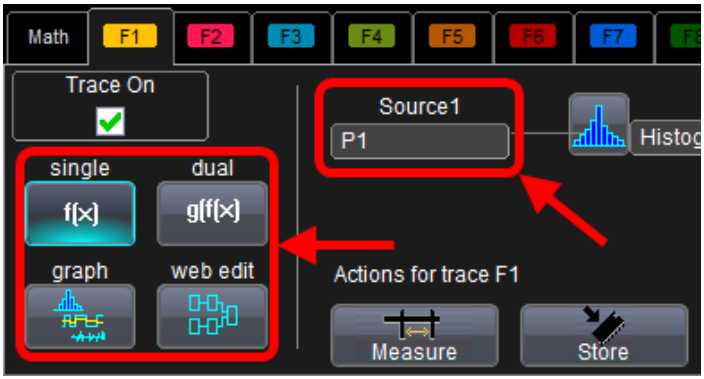
- **Using the Fx Buttons on the Math Dialog** - After directly touching an **Fx** button on the **Math** dialog, the **Select Math Operator** pop-up is shown.



Math functions are categorized into Basic and Special.

- **Using a Corresponding Fx Tab/Dialog** - After directly accessing a corresponding **Fx** dialog, touch the **Operator** control and the **Select Math Operator** pop-up is shown.

Regardless of how you performed the previously described initial steps, at this point access your corresponding **Fx** dialog if you want to change other setup items as follows:



- You can modify the source of your waveform used on a Math trace using the **source (Source 1)** control.
- Touch the **Single** function button if you want to perform just one math function on the trace, or touch the **Dual** function button to perform math on math (shown respectively, as follows).
- Touch the **Graph** button, and then touch inside the **Graph with** control to select a graph mode.
- Use the **web edit** button to access the Processing Web and form sequence highly detailed math functionality.

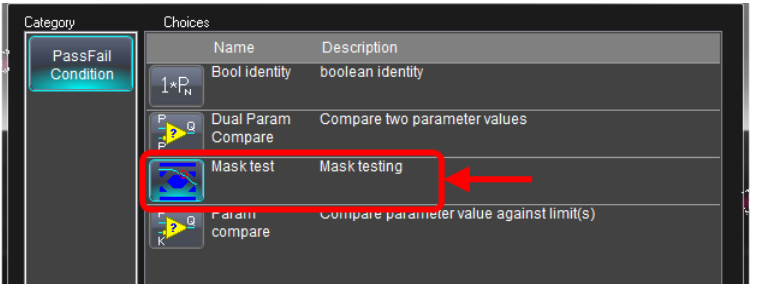
Mask Testing

Users may load or create a pixel-based mask on the display grid using a variety of methods. Test conditions can be set, and a pass/fail result returned based on whether the condition was found to be true or false. The source of the mask is always a trace (Channel, Zoom, Math waveform).

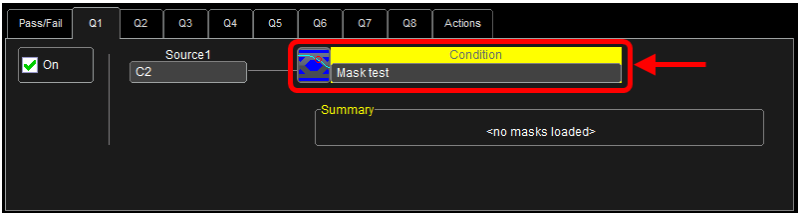
Creating a Mask

1. After selecting **Analysis → Pass/Fail**, the **Pass/Fail** dialog is shown.

- If you touch the **Q1 button**, a pop-up is shown where you can select the **Mask test** Pass Fail Condition.

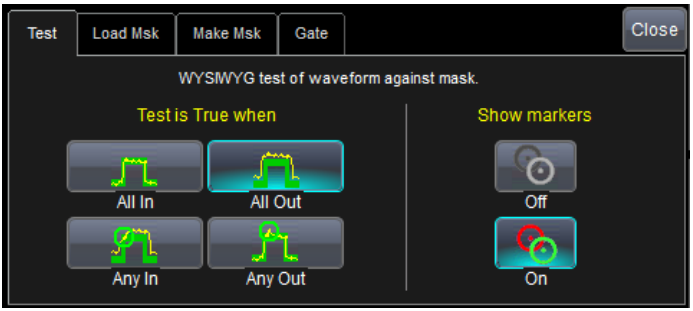


Now, the Q1 dialog shows the Mask test condition selected.



- If you touch the **Q1 tab**, the Q1 dialog is shown. Touch **Condition** and select the **Mask test** Pass Fail Condition from the pop-up.

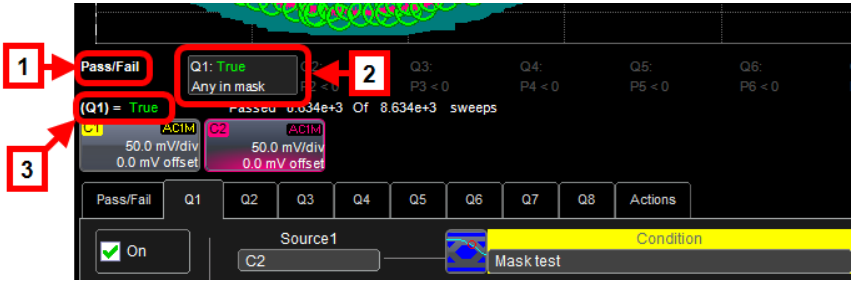
2. With the **Mask test** Pass Fail Condition selected, the **Test**, **Load Mask**, **Make Mask**, and **Gate** right-hand dialogs are shown and are where you manage, make, and apply gates to your mask.



For more detailed information about these right-hand dialogs, refer to **Pass/Fail Testing** (on page 176).

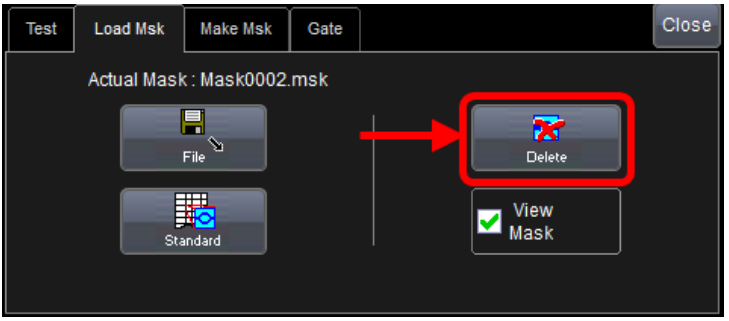
Quick Access to Pass/Fail Setup Dialogs

You can quickly gain access to the **main Pass/Fail** dialog, a **(Qx)** setup dialog, or the **Actions** dialog, by touching one of the following respective sections below the grid display.



Removing a Mask from the Display

Quickly remove a mask by accessing the **Qx** dialog. On the **Load Mask** right-hand dialog, click the **Delete** button.



Mask testing can be done using an existing mask, or by using a mask created from your actual waveform, with vertical and horizontal tolerances that you define. Existing masks can be loaded from a floppy disk or from a network.

You can set your mask test to be True for waveforms All In, All Out, Any In, or Any Out. For example, if you select All In, the test becomes False if even a single waveform falls outside the mask.

Masks that you create from your waveform can be confined to just a portion of the trace by use of a measure gate. Refer to the **Measure Gate** online help topic for more information on how this feature works.

Right-Hand Dialogs

- On the **Test** right-hand dialog, make a selection in the **Test is True when** group of buttons (as follows).

> **NOTE:** The previous selection is for **All In** and means the test is False when a single waveform falls outside the mask.

From the **Show Markers** section of the dialog, choose whether or not to have mask violations displayed by touching either the **Off** or **On** button, respectively.

- When loading a pre-existing mask, use the **Load Mask** right-hand dialog. Using the **File** button, you can then enter the file name or browse to its location.
- When creating a new mask, use the **Make Mask** right-hand dialog.

  Touch the **Browse** button to create a file name and location for the mask if you want to save it.

  Touch inside the **Ver Delta** and **Hor Delta** fields and enter boundary values, using the pop-up numeric keypad. You can also use the **Make from Trace** button to instantly create a mask from a new waveform.
- When creating a new mask, use the **Make Mask** right-hand dialog.
- On the **Gate** right-hand dialog, you can enter values in the **Start** and **Stop** fields to constrain the mask to a portion of the waveform. Or, you can simply touch and drag the Gate posts, which initially are placed at the extreme left and right ends of the grid.

WaveScan Overview

WaveScan enables you to search for unusual events in a single capture, or to scan for an event in many acquisitions over a long period of time. You can select from more than 20 search modes (frequency, rise time, runt, duty cycle, etc.), apply a search condition (slope, level, threshold, hysteresis), and begin scanning in a post-acquisition environment. Since the scanning modes are not simply copies of the hardware triggers, but software triggers, the capability is much greater.

For instance, there is no frequency trigger in any oscilloscope, yet WaveScan allows for quick frequency scans. You can accumulate a data set of unusual events separated by hours or days, enabling faster debugging. The events are time stamped, table indexed, and event rows can be selected for individual viewing.

You can also set actions to occur automatically when unusual events are found: stop the acquisition, emit an audible beep, output a pulse as shown in **Auxiliary Output Signals** (on page 217), print the screen as shown in **Printing and Hardcopy Functions** (on page 211), save waveforms as shown in **Saving and Recalling Waveforms** (on page 203), or create a LabNotebook™ entry as shown in **My Lab Notebook Overivew** (on page 196).

Signal Views

WaveScan provides distinct views of your signal:

- **Source View** highlights all occurrences of edges that meet your criteria.
- **Scan Overlay** places all captured edges one on top of the other in a separate grid. You can apply monochromatic persistence in this view.
- **Scan Histogram** provides a statistical view of edges that meet your search criteria.
- **Zoom View** allows you to expand a waveform feature vertically and horizontally; to apply further processing (using **Measure**); to **Store** it, or to apply a descriptive **Label** to the feature (as shown on the Actions portion of the trace dialog).

NOTE: The number of grids displayed varies from one to three grids depending on which views are enabled. WaveScan handles this function automatically, and there is no option to move traces from one grid to another, as would be the case under normal (non-WaveScan) operation.

Search Modes

Use the **Mode** control to select an appropriate Search to locate anomalies during acquisition. When each of the following modes are selected, a corresponding right-hand dialog provides additional controls. The following modes are available:

- **Edge Mode** – Designed for detecting the occurrence of edges; selectable slope and level.
- **Non-monotonic Mode** – For detecting threshold re-crosses; selectable slope, hysteresis, and level.
- **Runt Mode** – For detecting pulses failing to cross a threshold; selectable polarity and thresholds.
- **Measurement Mode** – For filtering and performing parameter measurements.

- **Measurement Mode** – Searches from 2 to 64 bits; ideal for bursted patterns where a PLL cannot lock.
- **Bus Pattern Mode** – Searches from 2 to 64 bits; enhances MSO search capabilities.

Parameter Measurements

Besides parameter measurements made during acquisition, post-acquisition measurements can also be made. The number of parameters available depends on the options loaded on your instrument. Measurements are made only on the events defined by your filter (search criteria). A **Filter Wizard** is provided to quickly establish statistical criteria such as ±1, 3, or 5 sigma.

Sampling Mode

Whenever WaveScan is enabled, the instrument reverts to Real-time sampling mode.

Customization Overview

The instrument provides powerful capability to add your own parameters, functions, display algorithms, or other routines to the oscilloscope user interface without having to leave the instrument application environment. You can customize the instrument to your needs by using the power of programs such as Excel™, Mathcad™, and MATLAB™, or by scripting in VBS. Whichever method you use, the results appear on the instrument's display together with the signals that you started with. This ability offers tremendous advantages in solving unique problems for a large range of applications, with comparatively little effort from you.

Instrument customization provides these important capabilities:

- Export data without leaving the instrument environment.
- Display results from external programs without leaving the instrument application environment.
- Perform additional oscilloscope operations on returned data, such as measuring with cursors, applying parameters, or performing additional functions on the waveform, in exactly the same way as for a normal waveform.
- Program the oscilloscope yourself.

The instrument does not just provide connectivity with data downloads to other programs. It provides true customizable interaction with these other programs, and allows you to truly customize the oscilloscope to do the exact job you want it to do. The advantages to this are many:

- Use the standard processing power of the instrument to do most of your calculations.
- Write the missing function, parameter, display algorithm, etc. that specifically applies to your need.
- View the final result on the instrument display, and use all of the instrument's tools to understand the result.
- Do additional processing on the result by applying standard instrument parameters and functions, or even more powerfully, adding chained customized functions. For example, you can do an Excel calculation on a result with a MATLAB function applied to it.

Documenting Your Work Using LabNotebook

Teledyne LeCroy's LabNotebook feature extends the documentation capabilities of your oscilloscope. It allows you to create an annotated notebook entry containing all displayed waveforms, the setup of the DSO, and user-supplied annotations. The notebook entry can then be converted to hardcopy format - .pdf, .rtf, or .html - and printed or e-mailed. You can also use the default report layout or configure your own, and even substitute your own company logo in the header.

Notebook entries are stored in an internal database and are available for recall at any time. Besides storing the waveform data, LabNotebook also stores your panel setups and parameter measurements. You can also back up the database to external media.

The Flashback feature allows you to recall the state of the DSO at a later date, including the saved waveforms and the DSO setup, so you can make additional measurements. A keyword filter makes it easy to find and recall a specific notebook entry.

You can choose which notebook to use for your entries, and label the notebook by project or user. This is especially useful if the oscilloscope is shared among several users and/or used for different projects as data can be kept separate how you see fit. Similarly, hardcopy reports can be stored in different folders.

NOTE: If your external monitor is connected, the LabNotebook automatically opens on the external monitor.

LabNotebook

When LabNotebook is accessed by **File → LabNotebook** on the menu bar, the main **LabNotebook** dialog is shown by default.

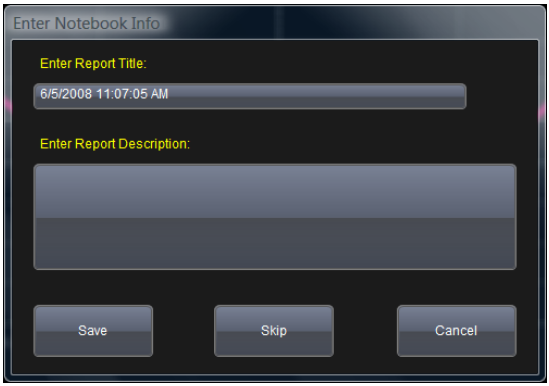
This dialog is where you can **store** and **create** LabNotebook entries. You also can **View**, **Create**, **E-Mail**, and select an **output format** for your reports.

NOTE: Before creating a new Notebook Entry, you should first configure corresponding settings in Preferences.

To **create a notebook entry**:

1. Either:
   - Touch **File → Create Notebook Entry** on the menu bar.
   - Touch the **Create** button on the main LabNotebook dialog.

   The **Enter Notebook Info** pop-up appears, where you can provide a title and comments for the entry. By default, the entry is titled with the current date and time.



2. Touch inside the **Title** control and provide a value.
3. If desired, touch inside the **Description** field, provide information and touch **Save**.

PLEASE NOTE THE FOLLOWING:

- When an entry is first created and Report Title and Description information is provided, your new entry is shown along with The Drawing Toolbar at the top of the screen.
- When finished and the Done button is touched from the Drawing Toolbar, your new entry is shown on the My Notebook Entries list.

My Notebook Entries list shows the entries you've already stored on your instrument. With a stored entry selected on the **My Notebook Entries** section of the dialog.

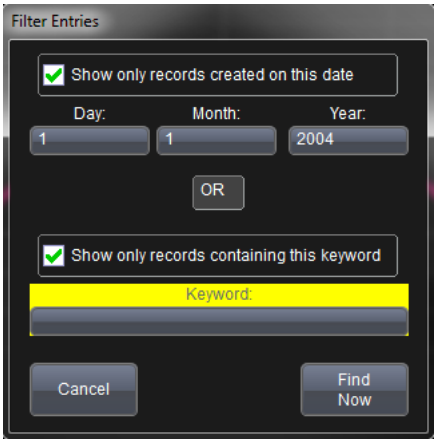
With a notebook entry selected, you can touch the **Flashback (Recall)** button to return your instrument to the state it was in when the Notebook Entry was saved. Exit Flashback by touching the Undo Flashback button in the top-right corner of the screen, or touch the Auto Trigger front panel control.

PLEASE NOTE THE FOLLOWING:

The flashback feature currently recalls the DSO Setup, and all displayed waveforms. Some of result data is not recalled, including:

- **Persistence data** - While it is saved in hardcopy and is printed on the report, it is not recalled during Flashback.
- **Histogram data** - Histograms internally have a 32-bit resolution, but when stored into a trace file and recalled during flashback they are clipped to 16-bits.
- **Floating point waveforms** - Certain math operations result in the creation of floating point waveforms with much higher resolution than can be stored in a 16-bit waveform file. This extra resolution is not preserved when traces are recalled using flashback.
- **Cumulative Measurements** - Any measurements on when the Lab Notebook entry is created are not saved individually in the database (other than being embedded in the hardcopy image). This means that when flashback is used, the measurements are recomputed using the recalled waveform data. Normally, doesn't pose a problem; however, if cumulative measurements were on when the entry was stored and the cumulative measurements accumulated data from multiple acquired waveforms, they lose their history and show instead only the results from the stored waveforms.

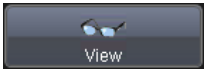
You can use the **Up** and **Down** arrows to move through your **My Notebook Entries** list one row at a time. If you have a large amount of entries, touch the **Filter** button and the **Filter Entries** pop-up is shown.



Provide a **Date** and/or **Keyword** and touch the **Find Now** button to apply your filter to the **My Notebook Entries** list.

Use the **View**, **Create Report**, and **E-Mail** buttons as desired.

- The **View** button shows a preview of your report.

  Exit the preview by touching the **Close** button at the right of the dialog.

- Create your report by first touching inside the **Format** control and selecting a format from the pop-up.

  Now, touch the **Create Report** button. In the **Create Report** window, select a folder to contain the report. Touch inside the **File name** control and enter a name using the pop-up keyboard. Click **OK** to create the report.

- The **E-Mail** button automatically sends the report data to the account you've specified in Preferences. See, **E-Mail** (on page 225) for more information.
- The **More Actions** button shows the **Specific Entry** dialog for the entry selected on the **My Notebook Entries** list. Using this dialog is explained in **Managing Notebook Entry Data** in the online help.

You can select the **Format** of your LabNotebook entry from **HTML**, **RTF**, and **PDF** choices. The **Delete** button removes the specific row selected on the **My Notebook Entries** list while the **Delete All** button removes every entry on the list.

Marking the **Multi Selection** checkbox shows the **Select All**, **Clear All**, **Select**, **Clear**, and **Print** buttons.

The **Select All**, **Clear All**, **Select**, and **Clear** buttons are used to select/deselect multiple entries on the **My Notebook Entries** list. The **Print** button can only be used for Multi Selection printing of **My Notebook Entries** from the main LabNotebook dialog.

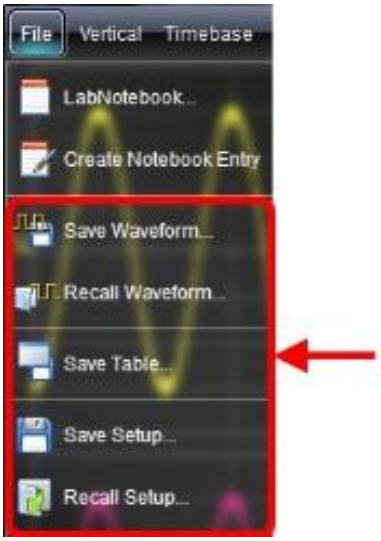
NOTE: If selected in Preferences, your entry can show your waveforms in print colors. This means it's printed on a white background in order to save printer ink. Otherwise, waveforms are shown on a black background.

Use the **Delete** button to delete the selected entry (or entries if the Multi Selection checkbox is marked). The **Delete All** button can be used to remove all notebook entries shown on the My Notebook Entries list with the touch of a single button.

Save/Recall

The **Save/Recall** section allows for storage and retrieval of **Waveforms**, **Table Data**, and **Instrument Setups**. It even provides **Disk Utilities** for arranging the file/folder structure on your instrument's hard drive.

Directly access each Save/Recall dialog (**Waveform**, **Table**, **Setups**, and **Disk Utilities** on the **File** menu on the menu bar.



A main Save/Recall dialog is shown providing buttons to access the aforementioned dialogs for specific Save/Recall functions.

NOTE: While the Disk Utilities (on page 220) is the final dialog of these Save/Recall functions, it's actually considered part of the Utilities menu and is therefore covered in that section of the documentation.

Saving and Recalling Setups

The Save/Recall Setup dialogs allow for quick saving and recalling of up to six oscilloscope panel settings internally on your instrument. If desired, you can also save and recall your oscilloscope panel settings as an .lss file to a specific hard disk location, a network location, or USB drive.

Saving Oscilloscope Setup(s)

Access the **Save Setup...** dialog by either selecting **File → Save Setup...** from the menu bar or clicking the **Save Instrument Setup** button on the main Save/Recall dialog. Now use one of the following two methods to save setup(s).

SAVING SETUP(S) INTERNALLY ON YOUR INSTRUMENT

Save your settings **internally on your instrument** by touching inside one of the six **SetupX** data entry controls on the **Save to Internal Setup...** part of the screen and providing a name. Now, touch its corresponding **Save** button directly to the left. Your setup file is then saved to the **D:\Internal Setups** location on your instrument and the current date/time is shown above the **SetupX** data entry control.

SAVING SETUP(S) DIRECTLY TO A FILE

Save your setup(s) **directly to a file** by touching the **File** button on the **Save To** section on the dialog. Now, touch inside the **Save files in directory** control and provide a path to the destination folder. Or touch **Browse** to navigate to the destination folder. Finally, touch the **Save Now** button.

Recalling Oscilloscope Setup(s)

Access the **Recall Setup...** dialog by either selecting **File → Recall Setup...** from the menu bar or clicking the **Recall Instrument Setup** button on the main Save/Recall dialog. Now use one of the following two methods to save setup(s).

RECALLING SETUP(S) INTERNALLY ON YOUR INSTRUMENT

Recall your settings located **internally on your instrument** by touching inside one of the six **Recall** buttons on the **Recall From Internal Setup...** part of the screen.

Each Recall button is labeled with a corresponding setup storage slot. If a setup is stored, **SetupX** is shown along with the **date/time of the save**, otherwise, the slot is labeled **Empty**.

Recalling Setup(s) Directly from a File

Recall your setup(s) **directly from a file** by using controls on the **Recall From File** section on the right side of the dialog. Touch inside the **Recall panel from file** data entry control and provide a path to the destination folder. Or touch **Browse** to navigate to the destination folder. Finally, touch the **Recall Now** button.

Recalling Default Settings

Your instrument's default settings can be recalled at any time using the **Recall Default** button.

Saving and Recalling Waveforms

Saving Waveforms

The Save Waveform dialog is used to save displayed waveforms to either a memory trace or to text or binary file formats.

Access the **Save Waveform** dialog by either selecting **File → Save Waveform** from the menu bar or clicking the **Save Waveform** button on the main Save/Recall dialog.

Use the numbered sections of this Save Waveform dialog, which correspond with the following explanations, to properly save your waveform(s).

1. Select either **Memory** or **File** by touching either respective button on the **Save To** portion of the dialog.

   NOTE: When Memory is selected, only Source and Destination controls are shown on the Save Waveform dialog. When File is selected, many more controls are available. Regardless, the controls are used as explained in the following steps.

2. Touch inside the **Source** control and select a source from the **Select Source** pop-up. The source can be any trace; for example, a channel (C1–C4), math function (F1–F4), or a waveform stored in non-volatile RAM (M1–M4).

3. **Destination** - Click to show the available memory traces when saving to memory.
4. Touch inside the **Trace Title** data entry control to change the default name of your waveforms (if desired).

CAUTION. You can change the name but not the sequence number. If you use a name ending with a number instead of a letter, the instrument may truncate the number. This is because, by design, the first waveform is automatically numbered 0, the second 1, and onward. For example, if you want to use waveform name XYZ32 but it is not preceded by waveforms XYZ0 through XYZ31, the waveform is renumbered with the next in sequence. If you need to use a number in your waveform's name, append an alpha character at the end of the number: XYZ32a, for example.

5. If you are saving to a file, touch the **Data Format** control and select a format type.
   - **Binary** - saves the file to Teledyne LeCroy's binary file format. This format is documented in various Remote Control Manuals for Teledyne LeCroy Oscilloscopes. Selecting Binary results in the smallest possible file size, and is recommended if you plan to recall waveforms to Teledyne LeCroy instruments.

     NOTE: Binary files can be converted to ASCII using Teledyne LeCroy utilities such as ScopeExplorer or WaveStudio.

   - **ASCII** -Text file (.txt extension).
   - **MATLAB** - Text file compatible with MATLAB (.dat extension).
   - **Excel** - Text file compatible with Excel (.csv extension).
   - **MathCad** - Text file compatible with Excel (.prn extension).
   - **Word** - Available when selecting the Binary format, specifies the samples in the output file are represented with 16 bits. Always use this option unless Byte mode is pre.
   - **Audio** to save your waveforms into the .wav format.
   - **WaveML** - . XML output, used for persistence traces.

6. Depending on your selection, you may need to touch the **SubFormat** control and select a subformat.
   - **Byte** - Available when selecting Binary format, specifies the samples in the output file are represented with 8 bits.

     NOTE: Using this option can result in a loss of output file resolution.

   - **Amplitude only** - Specifies the output file include amplitude data for each sample, but not sample time information.
   - **Time and Amplitude** - Specifies the output file include both time and amplitude data for each sample.
   - **With Header** - Specifies to include a header with scaling information.

   If you select **ASCII**, touch the **Delimiter** control and select a delimiter character from the pop-up menu. Choose from **comma**, **space**, **semicolon**, or **tab** delimiters.
7. You can use the **Auto Save** feature to automatically save a waveform to disk after each new trigger. You can enable Auto Save from the **Save Waveform** dialog by touching one of the **Auto Save** buttons.
8. Select **Wrap** (old files overwritten) or **Fill** (no files overwritten).
9. Touch the **Browse** button next to the **Save file in directory** control and navigate to the location where you want the file saved. The file name is assigned automatically and is shown under the control.
10. Finally, touch the **Save Now!** button.

Recalling Waveforms

NOTE: Only .trc files saved in binary format can be recalled into the oscilloscope.

Access the **Recall Waveform** dialog by either selecting **File → Recall Waveform** from the menu bar or clicking the **Recall Waveform** button on the main Save/Recall dialog.

1. Select either **Memory** or **File** by touching either respective button on the **Recall From** portion of the dialog.

   NOTE: When Memory is selected, only Source, Destination, and Show on recall controls are shown on the Recall Waveform dialog. When File is selected, many more controls are available. Regardless, the controls are used as explained in the following steps.

2. If recalling from Memory, touch inside the **Source** control and select a source stored in non-volatile RAM (M1–M4) from the **Select Source** pop-up.
3. Touch inside the **Destination** control and select a location for storage (memory or file) from M1 to M4.
4. **Show on Recall** - Mark this checkbox to have the memory trace shown on the grid display after recalling the waveform.
5. When saving a File, touch inside the **Show only files** control and select an area to limit the search (**channels**, **math functions**, or **memory**).
6. Touch inside the **Recall files from directory** data entry control and provide the path. You can also touch the **Browse** button and navigate to the file. Touch inside the **Next file will be recalled from data entry** control and provide the path or, touch the **Browse** button to navigate to the file.

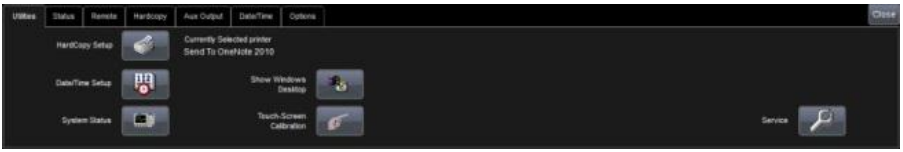
7. **Up /Down arrows** - Use these buttons to cycles through files in the selected folder from the **Show only files** control.
8. When finished, touch the **Recall Now!** button.

Utilities

Utilities settings are divided into three main sections: **Utilities**, **Disk Utilities**, and **Preferences** as seen when accessing **Utilities** from the menu bar.

Utilities

Selecting **Utilities → Utilities Setup...** shows the main **Utilities** dialog by default. The following controls are available from this dialog.



The **HardCopy Setup**, **Date/Time Setup**, and **System Status** buttons all open their corresponding dialogs.

NOTE: To the right of the **HardCopy Setup** button, display text indicates your currently selected printer for convenience.

When touched, the **Show Windows Desktop** button instantly minimizes the oscilloscope (and any other) applications.

Maximize the application by touching the shortcut icon located on the lower-right of the screen.

A sequence of calibration screens are shown when the **Touch-Screen Calibration** button is touched. These screens instruct you to touch a series of displayed crosses in order to improve precision and accuracy when using your touch screen.

The **Service** button is a section of the application reserved for qualified Teledyne LeCroy personnel. When touched, an access code pop-up is shown enabling Teledyne LeCroy technicians access to various service dialogs inside the oscilloscope software.

PLEASE NOTE THE FOLLOWING:

- Use a stylus for this procedure. Using your finger for the calibration prompts provides insufficient accuracy for the procedure.
- The calibration procedure times out after ten seconds pass and no cross is touched.
- Avoid parallax errors by placing your line of sight directly in front of each cross before touching it.

Status

Control values are shown for information about your instrument. Among them include your Hardware and Software options.

View the oscilloscope's system status (including software and hardware configurations) on this Status dialog. The dialog displays read-only system information including **model number**, **serial number**, **firmware version**, and **installed software and hardware options**.

Adding Software Options

New software options can be added after purchasing a code and then enabling the option on the oscilloscope. Call Teledyne LeCroy Customer Support to place an order and receive the code.

After adding new software options, the entire oscilloscope application needs to be restarted. Do this by touching the desktop shortcut.

Restart the Windows® operating system on your instrument (if necessary) by rebooting the oscilloscope. Do this by pressing the power switch, and then turning the power back on after a ten-second wait.

Upon initial power-up, the oscilloscope automatically loads the instrument application software along with any additional software options.

Remote Communication

Use the **Remote** dialog to setup remote communication. You can select a network communication protocol, establish network connections, and configure the Remote Control Assistant log from the **Remote** dialog. The choice of communication protocols is limited to TCPIP, GPIB, and USB488 (on specific models).

The Remote Control Assistant monitors communication between your PC and oscilloscope when you are operating the instrument remotely. You can log all events or errors only. This log can be invaluable when you are creating and debugging remote control applications.

PLEASE NOTE THE FOLLOWING:

- GPIB is an option that either requires a GPIB card to be installed in an open card slot on your oscilloscope or the use of an external USB to GPIB Teledyne LeCroy accessory. Your particular oscilloscope may support both, or only one of the options/accessories. For more information about which Teledyne LeCroy GPIB options and accessories your oscilloscope supports, visit teledynelecroy.com.
- The instrument uses Dynamic Host Configuration Protocol (DHCP) as its addressing protocol. Therefore, it is not necessary to set up an IP address if your network supports DHCP. If it does not, you can assign a static address in the standard Windows network setup menu.

Remote Communication Setup

If you are connecting the oscilloscope to a network, first contact your Information Systems administrator. If you are connecting the oscilloscope directly to your PC, connect a GPIB or Ethernet cable between them.

1. On the **Remote** dialog, make a **Port** selection: **TCPIP** (transmission control protocol/Internet protocol) or **GPIB** (general purpose interface bus). If you do not have a GPIB card installed, the GPIB selection will not be accessible.
2. If you are using GPIB, set a GPIB address by touching inside the **GPIB Address** data entry control and provide an address.

   If you are using TCPIP, press the **Net Connections** button; the Windows **Network Connections** window opens. You can reconfigure the oscilloscope's connection if it is already connected to the network or make a new connection.

NOTE: Your instrument allows you to restrict remote control access to certain clients. To restrict access, under Security, touch the Yes button and enter the IP addresses or domain name server names you want to restrict separated by a comma.

Configuring the Remote Control Assistant Event Log

1. Under **Remote Control Assistant**, touch inside the **Log Mode** data entry control. Select **Off**, **Errors Only**, or **Full Dialog** from the pop-up menu.
2. Export the contents of the event log to an ASCII text file by touching the **Show Remote Control Log** button. The **Event Logs** pop-up is shown. Touch inside the **DestFilename** data entry control and provide a file name using your preferred input control method. Additional information on using the touch screen controls can be found in the **Dialog Area** (on page 87).

   Then, touch the **Export to Text File** button.

Printing and Hardcopy Functions

Your instrument provides the ability to output files to printers or plotters print to file, or e-mail your files. Any Microsoft Windows® supported printer is supported by your instrument.

Printer Setup

1. Touch **File → Print Setup...** on the menu bar.
   OR
   Press the PRINT front panel button. Then, touch the **Print Setup...** button on the **Print** flyout menu.

   OR

   Touch **Utilities → Utilities Setup...** and click the **Hardcopy** tab.

   The Utilities **Hardcopy** dialog opens.
2. On the Hardcopy dialog, touch the **Printer** icon.

3. Under **Colors**, touch the **Use Print Colors** checkbox if you want the traces printed on a white background.
4. Touch inside the **Select Printer** control and choose a printer from the pop-up menu.
5. Touch the **Properties** button to see your printer setup.

4. Touch the icon for the layout **Orientation** you want: portrait or landscape.
5. Touch the **Hardcopy Area** control to choose which part of the screen you want to print from the pop-up menu.

Choose **Grid Area Only** if you do not need to print the dialog area and you only want to show the waveforms and grids. Choose **DSO window** if you want to print the dialogs with the waveforms and grids. Choose **Full Screen** if you want to print the entire screen.

Adding Printers and Drivers

NOTE: If you want to add a printer driver, the driver must first be loaded on the oscilloscope.

1. Touch **File → Print Setup...** on the menu bar.
   OR
   Press the PRINT front panel button. Then, touch the **Print Setup...** button on the **Print** flyout menu.

   OR

   Touch **Utilities → Utilities Setup...** and click the **Hardcopy** tab.
2. On the Utilities **Hardcopy** dialog, touch the **Printer** icon.

3. Touch the **Add Printer** button. A Microsoft Windows® Printer window opens where you can add a printer.

Printing a Screen Image

You can print in one of three ways:

- Press the **PRINT** front panel button. Then, touch the **Print Now** button on the **Print** flyout menu.

- Touch **File → Print** on the menu bar.
- Touch **Utilities → Utilities Setup...** and click the **Hardcopy** tab.

  On the **Hardcopy** dialog, touch the **Print Now** button.

NOTE: The instrument uses the Print settings on the Hardcopy dialog to print the screen image.

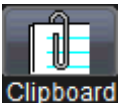
The **Hardcopy** dialog provides some additional functionality, like printing to the clipboard or to a file. You can also choose to print the waveform and grids only, the waveform and grids with the dialog, or the entire screen. You can also e-mail your screen images.

Clipboard

The **Clipboard** selection on the **Hardcopy** tab saves the screen image on the clipboard so you can paste a file into another application (like Microsoft Word, for example). Use either of the following methods to save a screen image to your clipboard:

Press the PRINT front panel button. Then, touch the **Save Screen To Clipboard** button from the Print flyout menu.

Touch **Utilities → Utilities Setup...** and click the **Hardcopy** tab. On the Hardcopy dialog, touch the **Clipboard** button.



1. Touch the **Colors** control and choose **Standard** to print the screen as it appears, **Print** to print the waveforms on a white background, or **Black & White** to print the waveforms in black & white.

   NOTE: Choosing Print colors saves printer toner or ink.

2. Touch the **Hardcopy Area** control to choose which part of the screen you want to print. Choose **Grid Area Only** if you do not need to print the dialog area and you only want to show the waveforms and grids. Choose **DSO window** if you want to print the dialogs with the waveforms and grids. Choose **Full Screen** if you want to print the entire screen.
3. Touch the **Print Now** button.

File

The **File** selection on the **Hardcopy** tab saves the screen image as a file to storage media such as a USB drive or hard drive. Use either of the following methods to save a screen image to a file.

Press the **PRINT** front panel button. Then, touch the **Save Screen To File** button from the Print flyout menu.

Touch **Utilities → Utilities Setup...** and click the **Hardcopy** tab. On the Hardcopy dialog, touch the **File** button.

1. Touch inside the **File Format** data entry control and select a graphic file format from the pop-up menu.
2. Touch the **Colors** control and choose **Standard** to print the screen as it appears, **Print** to print the waveforms on a white background, or **Black & White** to print the waveforms in black & white.

   NOTE: Choosing Print colors saves printer toner or ink (when you eventually do print from the file).

3. Touch inside the **File Name** data entry control and provide a name for the display image using your preferred input control method. Additional information on using the touch screen controls can be found in the **Dialog Area** (on page 87).
4. Touch inside the **Directory** data entry control and provide the folder path for the resulting printout. Or touch the **Browse** button and navigate to the folder.
5. Touch the **Hardcopy Area** control to choose which part of the screen you want to print.
   - Choose **Grid Area Only** if you do not need to print the dialog area and you only want to show the waveforms and grids.
   - Choose **DSO window** if you want to print the dialogs with the waveforms and grids. Choose **Full Screen** if you want to print the entire screen.
6. Touch the **Print Now** button.

E-mail

The **E-mail** selection on the **Hardcopy** tab gives you the option to e-mail your screen images, using either the MAPI or SMTP protocols. Before you output to e-mail from the **Utilities** dialog, you first have to set up the e-mail server and recipient address in **Preference Setup...**. Choose from either of the following methods to e-mail your screen image:

Press the **PRINT** front panel button. Then, touch the **Send Screen To E-mail** button from the Print flyout menu.

Touch **Utilities → Utilities Setup...** and click the **Hardcopy** tab. On the Hardcopy dialog, touch the **E-Mail** button.

1. Touch inside the **File Format** data entry control and select a graphic file format from the pop-up menu.
2. Touch the **Colors** control and choose **Standard** to print the screen as it appears, **Print** to print the waveforms on a white background, or **Black & White** to print the waveforms in black & white.
3. Touch the **Prompt for message to send with mail** checkbox if you want to include remarks with the image.
4. Touch the **Hardcopy Area** control to choose which part of the screen you want to print. Choose **Grid Area Only** if you do not need to print the dialog area and you only want to show the waveforms and grids. Choose **DSO window** if you want to print the dialogs with the waveforms and grids. Choose **Full Screen** if you want to print the entire screen.
5. Touch the **Print Now** button.

PLEASE NOTE THE FOLLOWING:

- The instrument's hard disk is partitioned into drive C: and drive D:. Drive C: contains the Windows operating system and the instrument application software. Drive D: is intended for data files.
- Once you have configured your various settings from the Hardcopy dialog, you can touch the Print front panel button and choose any of the configured options from the Print flyout menu. The instrument automatically uses the additional file settings to save the screen image to the file.

Aux Output

The **Aux Output** dialog allows you to specify Auxiliary and Calibration Output details.

1. If you want a specialized output, touch one of the following buttons under **Use Auxiliary Output For**: **Square Wave**, **Trigger Enabled**, **Trigger Out**, **Pass/Fail**, **or Off**.

   NOTE: If **Pass/Fail** is selected on this **Use Auxiliary Output For** section of the dialog, a **Pulse Duration** data entry control is made available. Provide a value within your instrument's specified range (varied based on your specific model, refer to datasheet specifications at **teledynelecroy.com** for details) using your preferred input control method. Additional information on using the touch screen controls can be found in the **Dialog Area** (on page 87).

2. On the Use Calibration Output For section of the dialog, choose **Square**, **DC Level**, or **Off**. If you want a 1 kHz, 1 V Square Wave, touch the **Set to 1 kHz, 1 V Square Wave** button.

   Additional controls are made available based on **Square** or **DC Level** selections as follows:

   - If you selected **Square** on the **Use Calibration Output For** section of the dialog, a **Frequency** data entry control is made available. You can set a value using your preferred input control method.
   - If you selected **Square** or **DC Level** on the **Use Calibration Output For** section of the dialog, an **Amplitude into 1 MΩ** data entry control is made available. Provide a desired value using your preferred input control method.

Auxiliary Output Signals

A calibration signal and the following additional signals can be output through the connector labeled AUX OUT on your oscilloscope. Use the Auxiliary Output to send the following signals to other instruments:

- **Trigger Enabled** - This function can be used as a gating function to trigger another instrument when the oscilloscope is ready.

- **Trigger Out** - This function can be used to trigger an external oscilloscope.

- **Pass/Fail** - Allows you to set a pulse duration (varied based on your specific model, refer to specifications at teledynelecroy.com for details); generates a pulse when pass/fail testing is active and conditions are met.

- **Fast Edge** - Some models provide this signal output used to deskew multiple channels. The Fast Edge connection varies based on model and is either SMA or BNC.

Calibration Output Signals

A calibration signal can be output from the Probe Calibration Hook on the front of the oscilloscope. The following Calibration Output Signals are available for use:

- **Square Wave** - You can set a Frequency value (varied based on your specific model, refer to specifications at teledynelecroy.com for details).

- **DC Level** - This is a reference level.

- **Off** - This function turns off the Auxiliary Output signal.

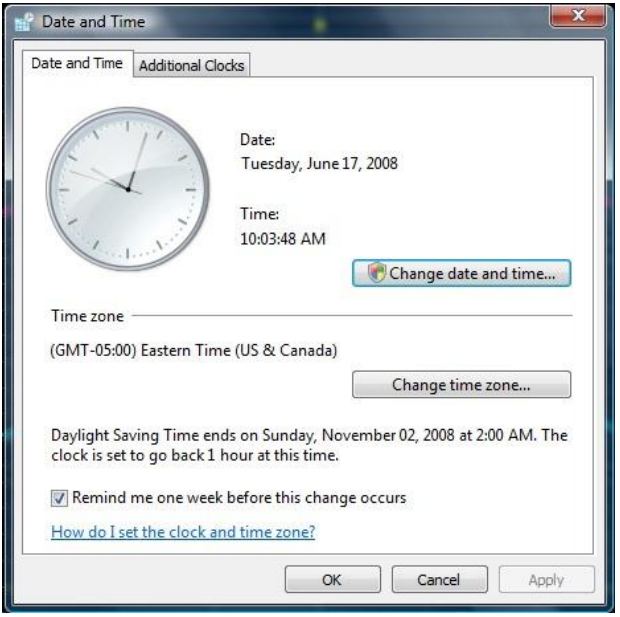
Date/Time

From the **Date and Time** tab on the **Utilities** dialog, you can manually set the time and date or get it from the Internet. If you elect to get the date and time from the Internet, you need to have the oscilloscope connected to the Internet through the LAN connector on your instrument's I/O panel. You can also set time zones and daylight savings time.

1. You can **set the Date and Time manually** by providing a value in the **Hour**, **Minute**, **Second**, **Day**, **Month**, and **Year** using your preferred input control method. Additional information on using the touch screen controls can be found in the **Dialog Area** (on page 87). After providing values, touch the **Validate Changes** button.
2. You can **set the Date and Time from the Internet** by first verifying that your oscilloscope is connected to the Internet, and then touching the **Set from Internet** button.

   NOTE: The Simple Network Time Protocol (SNTP) is used.

3. You can also set the Date and Time using Windows® by touching the Windows Date/Time button. Windows shows a **Date and Time Properties** pop-up where the date and time can be configured.


Date and Time
Date and Time
Additional Clocks
Date:
Tuesday, June 17, 2008
Time:
10:03:48 AM
Change date and time...
Time zone
(GMT-05:00) Eastern Time (US & Canada)
Change time zone...
Daylight Saving Time ends on Sunday, November 02, 2008 at 2:00 AM. The clock is set to go back 1 hour at this time.
Remind me one week before this change occurs
How do I set the clock and time zone?
OK
Cancel
Apply

Options

The **Options** dialog is used to add or remove software options. Contact Teledyne LeCroy for more information using **Contact Teledyne LeCroy for Support** , or visit our Website at teledynelecroy.com/options.

This dialog also shows your **ScopeID** and **Serial #**.

Disk Utilities

Use the Disk Utilities dialog to arrange the file/folder structure on your instrument's hard drive. You can delete files, folders, or create new folders.

NOTE: All Disk Utilities can also be accomplished using the standard Microsoft Windows® file management tools.

Access the **Disk Utilities** dialog by selecting **Utilities → Disk Utilities** from the menu bar.

1. **Delete a single file** by first touching the **Delete** button on the dialog (just to make sure it's selected).

   - Now, touch inside the **Current folder** data entry control and provide the path to the folder containing the file for deletion.
     OR
     Touch the **Browse** button and navigate to the folder.
   - Touch inside the **File to be deleted** data entry control and provide a file name using your preferred input control method. Additional information on using the touch screen controls can be found in the **Dialog Area** (on page 87).
     OR
     Touch the **Browse** button and navigate to the file.

     NOTE: You can also use the **up down arrows** to move through the files contained in the **Current folder** selected.

   With the desired file for deletion located, touch the **Delete File** button.

2. **Delete all files in a folder** by repeating the aforementioned **Delete a single file** process (up to the first bullet only using the **Current Folder** control).

   With the desired folder for deletion located, touch the **Empty Folder** button.

3. **Create a Folder** by first touching the **Create** button on the dialog (just to make sure it's selected).

   - Touch inside the **Current folder** data entry control and provide the path for folder creation and **be sure to include the folder name**.
   - Now, touch the **Create Folder** button.

NOTE: Disk Space data for Size, Free, and File(s) is available on the far right of the dialog for convenience.

Preferences

A variety of customizable preferences can be set on your instrument. Access Preferences by touching **Utilities → Preference Setup...** on the menu bar.

Selecting **Utilities → Preference Setup...** shows the main **Preferences** dialog by default. The following controls are available from this dialog:

1. You can choose to have audible confirmation each time you touch a screen or front panel control by marking the **Enable** checkbox on the **Audible Feedback** section of the dialog. With Audible Feedback enabled, the oscilloscope beeps each time you touch the screen or a front panel control.

2. You can choose to have your instrument automatically re-calibrate itself whenever there is a significant change in ambient temperature by marking the **Enable** checkbox on the **Automatic Calibration** section of the dialog.

   NOTE: If you do not enable this option, the oscilloscope re-calibrates only at startup and whenever you make a change to certain operating conditions.

3. If the option is available on your oscilloscope, you can set up the oscilloscope to optimize either **Analysis** (acquisition and calculation speed) or **Display** (update rate/speed) using the buttons provided on the **Optimize For** section of the dialog.

   Available choices are presented as a spectrum with highest values at **Analysis** and **Display** extremes.

   Select one of the buttons for the desired performance optimization.

   Example reasoning for Analysis optimization would be its persistence or averaging usefulness. In such a case, giving higher priority to waveform acquisition at the expense of display update rate makes practical sense.

Acquisition

Access the **Acquisition** preference settings in the following manner:

1. On the **Offset Setting constant in** area of the dialog, touch either the **Div** or **Volts** button.

   As you change the gain, this control allows you to either keep the vertical offset level indicator stationary (when **Div** is selected) or to have it move with the actual voltage level (when **Volts** is selected). The advantage of selecting **Div** is that the waveform remains on the grid as you increase the gain; whereas, if **Volts** is selected, the waveform could move off the grid.

   NOTE: Regardless of whether you select Volts or Div, the Offset shown in the channel setup dialog always indicates volts. However, when Div is selected for the Offset Control, the offset in volts is scaled proportional to the change in gain, thereby keeping the division on the grid constant.

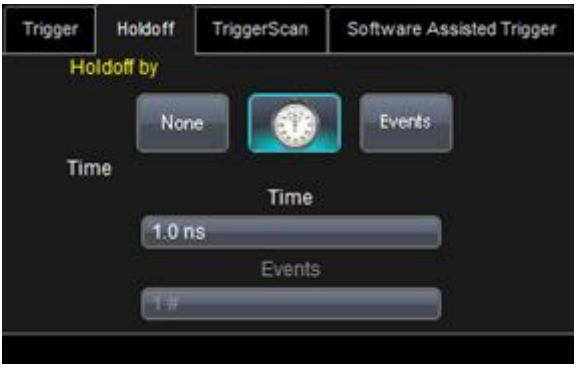
2. On the **Delay Setting constant in** area of the dialog, touch either the **Time** or **Div** button.

   As you change the timebase, this control allows you to either keep the horizontal offset indicator stationary (when **Div** is selected) or to have it move with the trigger point (when **Time** is selected). The advantage of selecting **Div** is that the trigger point remains on the grid as you increase the timebase; whereas, if **Time** is selected, the trigger point could move off the grid.

   NOTE: Regardless of whether you select Time or Div, the Delay shown in the timebase setup dialog always indicates time. However, when Div is selected for Delay In, the delay in time is scaled proportional to the change in timebase, thereby keeping the division on the grid constant.

3. If this checkbox control is available on your oscilloscope, you can mark the **Reset trigger counter before starting a new acquisition** checkbox on the **Trigger Counter Setting** area of the dialog.

This preference clears the trigger counter each time the oscilloscope issues an arm acquisition command and applies when you have set a trigger Holdoff condition in the Trigger dialog in either time or events:



The default condition of this control is off (unchecked).

Acquisition Status

For each general category of oscilloscope operation, you can view a summary of your setups. Access these status dialogs by making the following menu bar selections:

- **Vertical → Channels Status**
- **Timebase → Acquisition Status**
- **Trigger → Acquisition Status**
- **Math → Math Status**, **Zoom Status**, or **Memory Status**

In addition to these dialogs, summaries are also provided for XY setups, memory (M1-M4) setups, and time stamps for sequence mode sampling.

E-Mail

Before you can send e-mail from the oscilloscope, configurations must be made on this dialog.

1. On the **E-Mail Server** section of the dialog, choose a server protocol:
    - **MAPI** (Messaging Application Programming Interface) is the Microsoft interface specification that allows different messaging and workgroup applications (including e-mail, voice mail, and fax) to work through a single client, such as the Exchange client. MAPI uses the default Windows e-mail application.
    - **SMTP** (Simple Mail Transfer Protocol) is a TCP/IP protocol for sending messages from one computer to another through a network. This protocol is used on the Internet to route e-mail. In many cases no account is needed.
2. Provide values for **SMTP Server** and **Address** fields in the **Configuration** section of the dialog:
    - **If you chose MAPI**, touch inside the **Originator Address (From:)** data entry field and provide the instrument's e-mail address. Then touch inside the **Default Recipient Address (To:)** data entry field and provide the recipient's e-mail address.
    - **If you chose SMTP**, touch inside the **SMTP Server** data entry field and provide the name of your server. Touch inside the **Originator Address (From:)** data entry field and provide the instrument's e-mail address. Then touch inside the **Default Recipient Address (To:)** data entry field and provide the recipient's e-mail address.
3. The **Overview of E-Mail modes** section of the dialog provides helpful descriptions for your Server selection (made during the first step in this topic).
4. Use the **Send Test Mail** button to ensure proper E-Mail configuration by way of sending a confirmation message.

Color

You can customize the Colors used for **Channels**, **Math**, and **Memory** traces both when shown on your instrument and when used in print output.

NOTE: These color settings match a waveform on the grid display (both on-screen and printed) and show consistently on corresponding dialogs, tables, and trace descriptor labels.

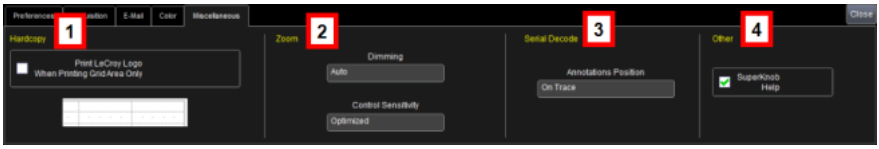
Numbered sections on this dialog correspond with the following explanations.

1. Make color selections for **Channels** (Screen and Print) by touching one of the color swatches. The Color pop-up control is shown and may be used to specify your desired color.
2. Just like Channels, make color selections for **Math Traces** (Screen and Print) by touching one of the color swatches. The Color pop-up control is shown and may be used to specify your desired color.
3. Again, just like Channels, make color selections for **Memory Traces** (Screen and Print) by touching one of the color swatches. The Color pop-up control is shown and may be used to specify your desired color.
4. You can use the **Factory default colors** button to instantly recall the original color settings for your instrument.

   NOTE: Print colors are used only when the Colors control is set to Print on the Hardcopy dialog in Utilities → Utilities Setup... allowing colors to still appear when printed on white paper in order to save ink/toner. For convenience, the Preview print colors button is provided on this portion of the dialog. When the button is touched, a preview is generated on the grid display area. A subsequent touch of the button closes the preview.

Miscellaneous

Other Preference setting controls are shown on the Miscellaneous dialog as follows:



Numbered sections on this dialog correspond with the following explanations.

1. You can add the Teledyne LeCroy Logo to hardcopies of your grid display waveforms by marking the **Print Teledyne LeCroy Logo When Printing Grid Area Only** checkbox on the **Hardcopy** section of the dialog.
2. You can adjust the **Dimming** and **Control Sensitivity** of **Zoom** traces as follows:

- Use the **Dimming** control to choose select **On**, **Off**, and **Auto** values. This controls the darkening/shading of waveform areas not part of the Zoom trace.
- Use **Control Sensitivity** to choose **Legacy** or **Optimized** values

3. If you have **Serial Data Debug Solutions** installed on your oscilloscope, you can control Annotations being put **On Trace** (on all traces) or **On Noisy Trace** (only on noisy traces).
4. You can shut off the SuperKnob Help flyout menu by un-marking the **SuperKnob Help** checkbox on the **Other** section of the dialog.

System Recovery Tool

Your oscilloscope is designed to operate reliably for many years. The application software operating the instrument runs on a Windows platform. The loading or incomplete removal of additional Windows applications can cause problems in the stability of the operating system. Severe cases may require a reloading of the base operating system and oscilloscope application. Teledyne LeCroy provides you with an Acronis recovery application and a backup image in an extra partition on the instrument's hard drive.

PLEASE NOTE THE FOLLOWING:

- The recovery process produces a replica of the operating system and oscilloscope application software at the current revision levels when the oscilloscope was manufactured. Any further revisions of the application software, Windows operating system, and virus scan definition files are not automatically upgraded. Therefore, after completion of the disk image recovery, it is highly recommended to search vendor Web sites and upgrade the individual components to current revision levels.
- After the recovery procedure is completed, you must activate Windows, either by Internet connection to Microsoft's Web site or by telephone. Have your Windows Product Key number (located on the rear of the oscilloscope) handy during Widows reactivation.
- The current oscilloscope application software can be downloaded directly from the Teledyne LeCroy website at teledynelecroy.com. Since the calibration data for the oscilloscope is stored in the D: drive, current calibration constants are not overwritten during the recovery process.

Since third-party recovery software is used, our instructions certainly may not be the most definitive or current. We advise you to take advantage of resources available on the **Acronis** website - they maintain versions of their product manuals from the following locations:

Acronis True Image Home

http://www.acronis.com/homecomputing/download/docs/

Acronis True Image Echo Workstation

http://www.acronis.com/backup-recovery/advanced-workstation/index.html

NOTE: The following procedures cover basic steps for running the True Image Echo Workstation. For more definitive documentation refer to their aforementioned documentation resources.

Teledyne LeCroy provides you with a recovery application and a backup image in an extra partition on the instrument's hard drive. The recovery process is easy to perform, using the Recovery Wizard. After the recovery procedure is done, you must activate Windows, either by Internet connection to Microsoft's Web site or by telephone. Have your Windows Product Key number (shown on a sticker on your oscilloscope) handy during Widows reactivation.

Running the Acronis True Image Echo Workstation Recovery Application

1. Connect a network cable to the LAN port on the rear of the oscilloscope if you intend to activate windows through the Internet.
2. Connect a keyboard and a mouse to the oscilloscope.
3. Apply power to the oscilloscope.
4. As soon as the **Starting Acronis Loader... Press F11 for Acronis Startup Recovery Manager** message appears on the screen, press the **F11** key until the recovery software logo appears momentarily.

   The Acronis **True Image Echo Workstation** main window is displayed.

   NOTE: Do not press F11 before you see the Starting Acronis Loader message or you will enter the MB boot sequence selection.

5. Select **Recovery** from the **Main Menu**. The **Restore Data Wizard** opens.
6. Click **Next** on the **Welcome** page.
7. On the **Backup Archive Selection** page, you choose the zone where the recovery partition is located. Choose **Acronis Secure Zone** (this is where the recovery data is located on your oscilloscope) and click **Next**.
8. On the **Backup Date Selection** page, choose the date when the backup was created and to which state you want to revert your system and click **Next**.
9. On the **Restoration Type Selection** page, select **Restore disks or partitions** and click **Next**.
10. On the **Partition or Disk to Restore** page, select **SYSTEM (C:)** as the source and click **Next**.
11. On the **Restored Partition Type** page, select **Active** and click **Next**.

    NOTE: If a window appears asking if you want to buy Acronis products, click Do not show this message again and click OK.

12. The **Restored Partition Size** page displays the Partition size for the restoration. Nothing needs to be changed, simply click **Next**.
13. On the **Next Selection** page, you will be asked if you want to restore another partition or hard disk drive. Select **No, I do not** and click **Next**.
14. The **Restoration Options** page displays additional options, such as what to do after the restoration is complete and error handling. Simply click **Next** to use the default selections.
15. A summary window is displayed indicating that Acronis True Image is ready to proceed with the recovery of the C: partition. Click **Proceed** to start the recovery process.

    NOTE: This takes approximately 4 to 15 minutes depending on the version of Operating system that is being restored. The progress is displayed on the screen

16. Once the restoration is complete, an Information window is displayed indicating that the **Data was successfully restored**. Click **OK**.
17. Click **Operations → Exit**. The oscilloscope will restart and begin installing the required software. A message is displayed asking if you want to install Microsoft Office PowerPoint Viewer.
18. Click **Yes** to install PowerPoint Viewer. The **InsallShield Wizard** for Adobe Flash Player opens.
19. To install Adobe Flash Player, click **Install** and then **Finish**. The X-Stream software installer screen appears.
20. Click **Next** to continue. The License Agreement page is displayed.
21. Click **I Agree**. The **Choose Components** page is displayed.
22. Select **all X-Stream components** and click **Install**.

    NOTE: A Windows Security window may be displayed indicating that Windows can't verify the publisher of this driver software. Choose Install this driver software anyway and then click Install.

23. When the X-Stream installation is completed, reboot the oscilloscope.

    NOTE: Now you must activate Windows® using an Internet connection to the Microsoft Web site or by telephone. When activating, have the Windows Product Key number handy (it is affixed to the rear of the oscilloscope).

Restarting the Application

Upon initial power-up, the oscilloscope automatically loads the instrument application software. If you exit the application and want to reload it, touch the **shortcut icon** on the desktop:

NOTE: Maximize the application by touching the shortcut icon located on the lower-right of the screen.

Restarting the Operating System

If you need to restart the Windows® operating system, reboot the oscilloscope by pressing and holding in the power switch for 10 seconds, then turning the power on again.

Reference

Specifications

NOTE: Specifications are subject to change without notice.

Please refer to the Teledyne LeCroy website at teledynelecroy.com where detailed specification information is regularly maintained on corresponding product datasheets.

Certifications

This section certifies the instrument's Electromagnetic Compatibility (EMC), Safety and Environmental compliances.

EMC Compliance

EC Declaration Of Conformity - EMC

The oscilloscope meets intent of EC Directive 2004/108/EC for Electromagnetic Compatibility. Compliance was demonstrated to the following specifications as listed in the Official Journal of the European Communities:

EN 61326-1:2006, EN 61326-2-1:2006 EMC requirements for electrical equipment for measurement, control, and laboratory use. [1]

Electromagnetic Emissions:

CISPR 11:2003, Radiated and Conducted Emissions Group 1, Class A [2 3]

EN 61000-3-2:2006 Harmonic Current Emissions, Class A

EN 61000-3-3/A2:2005 Voltage Fluctuations and Flickers, Pst = 1

Electromagnetic Immunity:

EN 61000-4-2:2001 Electrostatic Discharge, 4 kV contact, 8 kV air, 4 kV vertical/horizontal coupling planes [4]

EN 61000-4-3:2006 RF Radiated Electromagnetic Field, 3 V/m, 80-1000 MHz; 3 V/m, 1400 MHz - 2 GHz; 1 V/m, 2 GHz - 2.7 GHz [4]

EN 61000-4-4:2004 Electrical Fast Transient/Burst, 1 kV on power supply lines, 0.5 kV on I/O signal data and control lines [4]

EN 61000-4-5:2006 Power line Surge, 1 kV AC Mains, L-N, L-PE, N-PE [4]

EN 61000-4-6:2007 RF Conducted Electromagnetic Field, 3 Vrms, 0.15 MHz - 80 MHz [4]

EN 61000-4-11:2004 Mains Dips and Interruptions, 0%/1 cycle, 70%/25 cycles, 0%/250 cycles [4 5]

1 To ensure compliance with all applicable EMC standards, high quality shielded interface cables should be used.

2 Emissions which exceed the levels required by this standard may occur when the oscilloscope is connected to a test object.

3 This product is intended for use in nonresidential areas only. Use in residential areas may cause electromagnetic interference.

4 Meets Performance Criteria "B" limits of the respective standard: during the disturbance, product undergoes a temporary degradation or loss of function or performance which is self-recoverable.

5 Performance Criteria "C" applied for 70%/25 cycle voltage dips and for 0%/250 cycle voltage interruption test levels per EN61000-4-11.

European Contact:

Teledyne LeCroy Europe GmbH
Waldhofer Str 104
D-69123 Heidelberg
Germany
Tel: (49) 6221 82700

AUSTRALIA & NEW ZEALAND DECLARATION OF CONFORMITY – EMC

Oscilloscope complies with the EMC provision of the Radio Communications Act per the following standards, in accordance with requirements imposed by Australian Communication and Media Authority (ACMA):

CISPR 11:2003 Radiated and Conducted Emissions, Group 1, Class A, in accordance with EN61326-1:2006 and EN61326-2-1:2006.

Australia / New Zealand Contacts:

Vicom Australia Ltd.
1064 Centre Road
Oakleigh, South Victoria 3167
Australia

Vicom New Zealand Ltd.
60 Grafton Road
Auckland
New Zealand

Safety Compliance

EC Declaration Of Conformity – Low Voltage

The oscilloscope meets intent of EC Directive 2006/95/EC for Product Safety. Compliance was demonstrated to the following specifications as listed in the Official Journal of the European Communities:

EN 61010-1:2010 Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 1: General requirements

EN 61010-2:030:2010 Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 2-030: Particular requirements for testing and measuring circuits

The design of the instrument has been verified to conform to the following limits put forth by these standards:

- Measurement Category II: equipment intended to be supplied from the building wiring with a nominal supply voltage up to 300V.
- Measurement Category 0: oscilloscope measurement terminals that are not intended to be directly connected to the MAINS supply.
- Pollution Degree 2: an operating environment where normally only dry, non-conductive pollution occurs. Occasionally a temporary conductivity that is caused by condensation must be expected. This location is a typical office/home environment.
- Protection Class I: grounded equipment in which protection against electric shock is achieved by Basic Insulation and a connection to the protective ground conductor in the building wiring.

U.S. Nationally Recognized Agency Certification

The oscilloscope has been certified by Underwriters Laboratories (UL) to conform to the following safety standard and bears UL Listing Mark:

UL 61010-1 Second Edition – Safety standard for electrical measuring and test equipment.

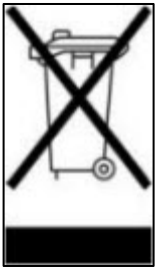
CANADIAN CERTIFICATION

The oscilloscope has been certified by Underwriters Laboratories (UL) to conform to the following safety standard and bears cUL Listing Mark:

CAN/CSA-C22.2 No. 61010-1-04. Safety requirements for electrical equipment for measurement, control and laboratory use.

Environmental Compliance

END-OF-LIFE HANDLING



The instrument is marked with this symbol to indicate that it complies with the applicable European Union requirements to Directives 2002/96/EC and 2006/66/EC on Waste Electrical and Electronic Equipment (WEEE) and Batteries.

The instrument is subject to disposal and recycling regulations that vary by country and region. Many countries prohibit the disposal of waste electronic equipment in standard waste receptacles. For more information about proper disposal and recycling of your Teledyne LeCroy product, please visit teledynelecroy.com/recycle.

RESTRICTION OF HAZARDOUS SUBSTANCES (ROHS)

This instrument has been classified as Industrial Monitoring and Control Equipment, and is outside the scope of the 2011/65/EU RoHS Directive until 22 July 2017 (per Article IV, Paragraph 3).

ISO Certification

Manufactured under an ISO 9000 Registered Quality Management System. Visit teledynelecroy.com to view the certificate.

Contact Teledyne LeCroy

Teledyne LeCroy Service Centers	
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